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GYPSUM STACK ROADS

SIMPLOT PLANT AREA
EASTERN MICHAUD FLATS SUPERFUND SITE

November 25, 2002

MFG, Inc.
consulting scientists and engineers

REMEDIAL DESIGN REPORT
AND
REMEDIAL ACTION WORK PLAN

GYPSUM STACK ROADS

SIMPLOT PLANT AREA
EASTERN MICHAUD FLATS SUPERFUND SITE

November 25, 2002

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1.0 INTRODUCTION

This document presents J.R. Simplot Company's Pre-Final Remedial Design Report (RDR) and Draft Remedial Action Work Plan (RAWP) for the control of fugitive emissions from permanent roads on the gypsum stack in the Simplot Plant Area of the Eastern Michaud Flats (EMF) Superfund Site located near Pocatello, Idaho. This action is part of the comprehensive Site remedy as described in the Record of Decision (ROD; USEPA, 1998) and subsequent Consent Decree for the Simplot Plant Area (USEPA, 2002).

This RDR/RAWP describes the actions required to implement the Gypsum Stack Roads component of the final remedy. As described in the Statement of Work for the Simplot Plant Area (Appendix B to the Consent Decree), a treatability study is suggested to assess the effectiveness of several alternatives to reduce visible fugitive emissions generated by vehicular traffic on permanent roads on the face of the gypsum stack. The alternatives identified in the Statement of Work include road base placement over a geofabric, and various combinations of periodic applications of water with or without additives. Simplot has selected the placement of road base as the preferred remedial action for the gypsum stack roads. This selection is based on mixed results achieved through previous informal applications of dust control products on the roads, a desire to minimize ongoing maintenance requirements associated with achieving the performance standard, and a preliminary evaluation of capital and operations and maintenance costs for a gravel road option versus the purchase and operation of a water truck.

The tasks that comprise the relatively straightforward design portion of this remedial component are addressed herein in Sections 2 and 3 and include the presentation of existing conditions, a discussion of the required work activities, and procedures for confirming that the performance standard for this element of work has been achieved. Section 3.1 describes the evaluation of several alternatives to control dust emissions from the Gypsum Stack Roads. Geotechnical data for the stack material are presented in Appendix A. Calculations supporting minimum strength requirements for the geofabric (geotextile) are presented in Appendix B. A set of construction drawings, graphically depicting the requirements of this work is provided as Appendix C. Because of the limited nature of the work, detailed technical specifications are not necessary to guide the completion of this element, however a statement of work has been prepared and is included as Appendix D. This Statement of Work will be used in conjunction with the drawings and other contract documents to solicit bids from contractors and to guide the implementation of the remedial action.

The remedial action (RA) planning portion of this document is presented in Section 4, which provides a detailed plan of action for completing the remedial activities. This RA Work Plan portion of the document addresses construction sequencing and scheduling, construction management for the Gypsum Stack Roads remediation and reporting requirements during construction. The required elements of a Construction Quality Assurance Plan for the Gypsum Stack Roads element of work are addressed in Section 5.2. A Construction Health and Safety Plan, required by the Consent Decree Statement of Work, will be submitted under separate cover.

1.1 Site Description and Project History

The EMF Site is located near the City of Pocatello, Idaho and includes two industrial facilities (Drawing 0121C-110; Appendix C): the FMC Elemental Phosphorus Facility (ceased operations in December 2001) and the J.R. Simplot Don Plant. FMC produced elemental phosphorus. The Don Plant produces phosphoric acid and a variety of liquid and solid fertilizers. The EPA has divided the Site into three areas: The FMC Plant Area includes the FMC facility and adjacent land owned by FMC; The Simplot Plant Area includes the Don Plant and adjacent land owned by Simplot; and The Off-Plant Area which surrounds the FMC- and Simplot-Plant Areas.

The Simplot Don Plant covers approximately 745 acres and adjoins the eastern property boundary of the FMC facility. The main portion of the plant lies approximately 500 feet southwest of the Portneuf River. Of the 745 acres, approximately 400 acres are committed to the gypsum stack. Another 185 acres are occupied by the plant and its infrastructure. A significant portion of the remaining acreage to the south and southeast of the plant consists of cliffs and rugged steep terrain. A Union Pacific Railroad right-of-way is adjacent to the northern fence line of the Don Plant and passes through the northern portion of the Simplot Subarea, paralleling U.S. Highway 30. Access to the Don Plant is provided by I-86 and U.S. Highway 30.

The Don Plant began production of a single superphosphate fertilizer in 1944. Phosphoric acid production began in 1954. Currently, the plant produces 12 principal products, including five grades of solid fertilizers and four grades of liquid fertilizers. The principal raw materials for the process are phosphate ore, which is transported to the facility via a slurry pipeline from the Smoky Canyon mine, sulfur, and ammonia. The primary byproduct from the Don Plant process is gypsum (calcium sulfate) which is stacked on site.

An Administrative Order on Consent (AOC) was issued by the U.S. Environmental Protection Agency (EPA) on May 30, 1991 and entered into voluntarily by FMC and Simplot. The AOC specified requirements for implementation of a Remedial Investigation (RI) and Feasibility Study (FS) to evaluate site conditions and remedial alternatives to address any potential threats to human health and the environment. Based on the findings of these studies, EPA issued a Record of Decision (ROD; USEPA, 1998), specifying the selected remedial actions for the Site on June 8, 1998. A Consent Decree (USEPA, 2002) between EPA and Simplot, which specified the conditions for implementing the selected remedial actions in the Simplot Plant Area was entered on May 9, 2002.

1.2 Remedial Action Objectives and Performance Standard for Gypsum Stack Roads

As set out in the Consent Decree Statement of Work, the objective of this action is to reduce visible fugitive emissions generated by vehicular traffic on permanent roads located on the face of the gypsum stack.

The performance standard for this element of work is the successful implementation of the final design.

2.0 DESIGN BASIS

This section presents the basis of the remedial design for the gypsum stack road barriers. Design considerations include: identification of permanent roads on the gypsum stack, characterization of the risks posed by the gypsum stack, identification of the necessary barrier thickness and identification of geotextile requirements.

2.1 Permanent Gypsum Stack Roads and Traffic Loads

Gypsum (hydrated calcium sulfate) is the primary byproduct from the phosphate ore processing operations conducted at the Simplot Don Plant. Approximately 6,000 tons (dry weight basis) of gypsum are produced daily and slurried to the gypsum stack. The gypsum stack has three separate cells: the lower stack and the eastern and western cells of the upper stack. At the time of the RI, Simplot was using only the upper stack. The lower stack, which had been used historically, was returned to service around 1994 and now gypsum slurry is applied to each of the cells in turn on a schedule of approximately six weeks. Decant water (water which remains after the gypsum solids have precipitated/settled out of solution) is collected from the top of the stacks and recycled back to the plant.

A rim ditching method is currently used to raise the gypsum stack. Under this method, track-mounted hydraulic excavators are used to pull up previously applied gypsum around the perimeter of each cell to construct new containment berms for each subsequent six-week cycle of slurry application. As a result, berm construction proceeds almost continuously. Another frequent operations/maintenance activity at the gypsum stack is the inspection and maintenance of the decant pumps located at the south side of the gypsum stack.

Roads located near and on the gypsum stack are shown on Figure 1. Details of the location and usage for these roads are summarized on Table 1 and described below.

<u>West Side Roads</u>

West Access Road	This is a permanent road that is founded on native soil over its entire length. It is used by pick-up trucks carrying workers to inspect the stack and service the decant pumps.

West Face Road	This is a permanent road founded on Gypsum. It is used primarily by pick-up trucks that shuttle workers to the berm-building equipment on the top of the stack and a fuel/service truck that maintains the equipment. The berm-building equipment (a dozer and two excavators) periodically traverse the road to reach the equipment shop in the Don Plant. Approximately twice a year, the lower portion of this road is used by a pipeline rooter service pick-up truck and trailer to reach Pipline Access Road # 1.
Pipeline Access Road #1	This is a temporary road founded on gypsum. It is used approximately twice per year by a pipline rooter service truck and trailer to clean the slurry pipelines. Simplot expects to abandon this road in five to ten years.
Pipeline Access Road #2	This is a temporary road founded on gypsum. It is used by pick-up trucks to carry workers to the berm building equipment at the top of the stack and the fuel/service truck. It is also used periodically by the dozer and excavators during the course of construction. This road is generally damp due to seepage of water from the impounded gypsum behind the top berms. Consequently, only minor dust is generated by road usage. Simplot expects to abandon this road in two to four years.
West End Road Storage Road Storage Loop & Lower Road	These are permanent roads founded on native soil.

<u>East Side Roads</u>

East Access Road	This is a permanent road. Approximately 1,100 feet of the lower section of the road is founded on gypsum. All other portions are founded on native soil. The road is used by pick-up trucks, a dump truck, and the fuel/service truck.

East Face Road	This is a permanent road founded on gypsum. It is used by pick-up trucks and the fuel/service trucks.
Off-Site Road	This is a permanent road founded on native soil. It is used to provide pick-up truck access to an off-site weather station.

In addition to the traffic loads discussed above, snow removal is performed by the dozer as needed on the stack area roads. However, fugitive emissions are not expected to be produced by this activity.

As indicated, the permanent roads founded on gypsum are the West Face Road, the East Face Road, and a segment of the lower East Access Road (see Figure 1). As such, these road segments are subject to this remedial action.

2.2 Risk Characterization

Human health risks associated with the inhalation pathway were estimated in EPA's risk assessment (Ecology and Environment, 1996). For the Simplot Plant Area risks were estimated for current workers (maintenance workers and gypsum stack workers). Risks were also estimated for current residents and for hypothetical future residents living adjacent to the FMC and Simplot plants. An emission inventory for Simplot and FMC sources was presented in Appendix AE of the RI Report (Bechtel, 1996). As shown, at the time of the RI constituents were emitted to the air from numerous sources at both the FMC and Simplot facilities. Air monitoring data from Site 2 (outside and adjacent to FMC's northern fence line) were used to estimate risks.

For gypsum stack workers, total Incremental Cancer Risks (i.e., the estimated cancer risks in excess of background) were estimated at 6.0 E-6 for inhalation of the chemical carcinogens cadmium, hexavalent chromium and arsenic and 2.0 E-5 for inhalation of the radiological carcinogen polonium-210. For residents Incremental Cancer Risks due to inhalation of chemical carcinogens were estimated from 7.22 E-7 to 2.24 E-6 (the background cancer risk was estimated at 1.5 E-6). Risk drivers were arsenic cadmium and hexavalent chromium. For radiological carcinogens, lead-210 and polonium-210 were the major risk drivers with estimated Incremental Cancer Risks ranging from 2.96 E-6 to 1.11 E-5 (background risks were estimated at 2.8 E-5).

Risks estimated above have been reduced due to the closure of the FMC facility in December 2001 and the resultant elimination of emission sources associated with operation. For example, of the total arsenic emissions from the facilities, the RI inventory allocated approximately 91 percent to FMC and 9 percent to Simplot. For cadmium, approximately 95 percent were associated with FMC sources and 5 percent with Simplot sources, and for chromium 83 percent were associated with FMC and 17 percent with Simplot. For radionuclides, the inventory allocated 94 percent to FMC and 6 percent to Simplot for lead-210, and 99.93 percent to FMC and 0.07 percent to Simplot for polonium-210. As shown, total emissions for the constituents of concern were much smaller for the Simplot Don Plant compared to the FMC facility.

The gypsum stack roads were identified as a relatively small source of constituents to air at the Simplot Don Plant. The RI emission inventory provides emission estimates for the entire gypsum stack operation (primarily roads and dike construction) and using these values will overestimate emissions from the roads alone. For arsenic, the total average emission from the stack was quantified at 0.05 percent of the total arsenic emissions from the FMC and Simplot facilities. Similarly, cadmium emissions from the stack were estimated at 0.21 percent of the total FMC/Simplot emissions and chromium emissions were estimated at 0.24 percent of the total. For radionuclides, the gypsum stack was quantified to emit 0.07 percent of the total FMC/Simplot emissions of lead-210 and 0.004 percent of the total polonium-210 emissions. While detailed modeling would be required to estimate the contribution of any one source to total air concentrations at a particular location, these values provide summary information on the low overall magnitude of the contribution of gypsum stack emissions to site-related risks associated with the air inhalation pathway.

As shown above, estimated risks associated with total emissions from the FMC and Simplot facilities during the RI are within the acceptable risk range of 10^{-6} to $10^{-4.}$ EPA's guidance (OSWER Directive 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions") states that EPA should clearly explain why remedial action is warranted if baseline risks are within the acceptable risk range of 10^{-6} to $10^{-4.}$ A risk manager may decide that a level of risk lower than 10^{-4} warrants remedial action where, for example, there are uncertainties in the risk assessment results. Simplot is not aware of any such explanation for the gypsum stack roads. In any event, it is worth noting that estimated health risks associated with emissions from the gypsum stack roads are minimal.

2.3 Gypsum Stack Geotechnical Properties

Gypsum stack materials currently support the existing equipment and are believed to have a relatively high bearing capacity. Limited geotechnical data are available for the gypsum stack. These data are preliminary results of laboratory tests performed on undisturbed samples collected at depth from the upper and lower stack areas and bulk samples of the gypsum from the upper stack. Two general types of gypsum are present within the stacks – gypsum produced by plant processes using calcined ore prior to 1991 ("calcined gypsum") and gypsum produced using uncalcined ore after 1991 ("uncalcined gypsum"). The majority of the gypsum stack roadways are founded on calcined gypsum.

Sample data (see Appendix A) indicate that gypsum content of the stack is consistently greater than 90 percent. Grain size analyses performed on the stack samples show the material consists primarily of particles in the silt-size range with three to fifteen percent sand-sized particles and zero to seven percent clay-size particles. However, it is noted that the gypsum is not silt, sand or clay, but a manmade material. As such, it has differing structural properties than these natural materials.

Testing indicates that samples of gypsum collected at depth (20-50 feet) have angles of internal friction of 48 degrees to 62 degrees with little to no cohesion. Near surface samples have a lower bound angle of internal friction of 44 degrees with no cohesion. (By comparison, angular rip rap rock typically has an internal angle at friction of 50 degrees with no cohesion and exhibits high bearing capacity). Based on these data and site experience that the stack materials are able to withstand the equipment loads shown on Table 1, it is concluded that the stack materials have relatively high bearing capacity.

2.4 Barrier Thickness

The purpose of the barrier system to be placed on permanent roads founded on gypsum is to reduce visible fugitive emissions generated by vehicle traffic on the face of the gypsum stack. More specifically, the barrier is intended to reduce the physical contact between equipment tires or treads and the gypsum materials that causes fugitive emissions.

In order to achieve this goal, the barrier must be thick enough to prevent the tires or treads from penetrating or otherwise wearing through the barrier and contacting the underlying gypsum. Structural considerations are not considered significant in the design of the barrier thickness as the available geotechnical data indicate that the stack materials have a relatively high bearing capacity, the existing roadways are well compacted by the years of vehicle traffic, and the foundation materials currently support the existing vehicle and equipment loads. Placement of a geotextile and compacted road base layer will reduce the existing loads by distributing them over a wider area but are not required to meet specific load dissipation requirements.

Considering the above, a geotextile topped by six-inch thick barrier of well-graded ¾-inch road base that meets the Idaho Department of Transportation (IDOT) standard specifications for aggregate for untreated base compacted to at least 90 percent of its maximum dry density (standard proctor) is considered appropriate to provide the necessary resistance to penetration and wearing. A lesser material thickness would likely provide acceptable results. However, for conservatism and to minimize future maintenance requirements, the six-inch thickness has been selected for this application. The underlying geotextile will provide visual indicator if repairs are needed in the event the road base layer is removed or eroded. Additional requirements for the geotextile are discussed in the next section.

2.5 Geotextile Requirements

Material requirements for the geotextile to be placed beneath the road base material have been developed based on performance for separation (i.e., to prevent migration of fines and packing of the road base into the underlying gypsum). Requirements for material performance for reinforcement (i.e., to provide structural support) are not warranted given the relatively high bearing capacity of the stack material (as discussed in Section 2.3).

In order to function adequately for separation, the geotextile must be capable of resisting localized deformations in and around individual stone particles induced by equipment loads on the overlying road base. Minimum material requirements for the geotextile properties of burst resistance, tensile strength and puncture resistance were calculated for this application and are listed on Table 2.

These requirements were developed for the maximum expected equipment load, a loaded dump truck or fuel truck with a conservatively (high) estimated ground pressure of 100 pounds per square inch (psi; see Table 1). A conservative cumulative reduction factor of 3.4 and an overall factor of safety equal to 2.0 were used. Details of the calculations performed to establish the geotextile requirements are presented in Appendix B.

3.0 REMEDIAL DESIGN

This section of the RDR/RAWP provides a general discussion of the required elements of the Gypsum Stack Roads remedial action and a detailed description of the procedures for confirming that the performance standards are met. Construction drawings and a statement of work, which will be used to solicit bids from contractors and to guide the implementation of the remedial action are included in Appendices C and D, respectively.

3.1 Alternatives Evaluation

As discussed previously in Section 1.0, Simplot has selected the placement of gravel road base on the permanent roads on the face of the gypsum stack as the preferred remedial action for this element of work. Don Plant operations personnel have reported that tests have been performed in the past using dust control additives such as magnesium chloride. The results of these informal tests indicate that such application does not result in lasting dust control under the routine traffic conditions on these gypsum roads. The other option considered to address fugitive dust emissions was the routine watering of the roads. To evaluate this alternative a cost analysis was performed, comparing both capital and ongoing operational costs associated with the placement of road base versus the cost of purchasing and operating a water truck.

The cost estimates prepared in performing this evaluation are included as Tables 3 and 4. Table 3 presents an estimate of approximately $70,000 to place a non-woven geotextile fabric and six inches of gravel road base on the West and East Face Roads and the segment of the lower East Access Road. Annual costs associated with maintaining the gravel roads in good condition are estimated at approximately $8,000 and include the cost to purchase and replace approximately 20% of the original quantity of road base each year. Table 4 presents a range of costs associated with the purchase of a water truck to be used to water the permanent face roads on the gypsum stack. These costs range from approximately $30,000 for a used water truck to $100,000 for a new water truck. Operating costs, assuming operation of the water truck six hours per day, seven days per week, twenty-six weeks per year, were estimated at $54,000 per year. Based on this cost evaluation it was determined that the placement of gravel road base is the most cost effective solution to achieve the objective and performance standard for this element of work.

3.2 Road Preparation

Prior to the placement of the geotextile fabric and gravel road base the permanent face roads will be graded to remove loose material, moisture conditioned and compacted to achieve a suitable subgrade for the placement of the road base. The roads shall be graded with a slight slope across the road surface from the outside edge of the road to the inside edge.

3.3 Geotextile Fabric

To provide a barrier between the gypsum and the gravel road base a geotextile fabric will be used to prevent the migration of fines and prevent the gravel from being packed down into the gypsum. For this purpose a non-woven geotextile meeting the minimum requirements listed on Table 2 will be used. Each subsequent roll of geotextile will be overlapped a minimum of one foot over the edge of the previous roll, and the overlapped materials will be sewn together using a j-stitch.

3.4 Gravel Road Base

A gravel road base with a maximum aggregate size of ¾-inch has been selected for use. This material shall meet the specifications of the Idaho Department of Transportation (IDOT) standard specifications for aggregate for untreated base, treated base and road mix contained in Section 703.04 of the IDOT highway specifications manual.

4.0 REMEDIAL ACTION PLAN

This section provides a detailed plan of action for completing the Gypsum Stack Roads remedial action and fulfills the requirements of the Remedial Action Work Plan, as described in the Consent Decree Statement of Work for the Simplot Plant Area. As discussed in Section 3.0, construction drawings and specifications are included as Appendices C and D, respectively. The proposed construction schedule and necessary quality control and quality assurance activities are also addressed in this section.

4.1 Proposed Schedule and Schedule Considerations

The Don Plant is an operating industrial facility and the gypsum stack is an integral part of the overall Don Plant process. Because the placement of the gravel road base on the permanent face roads of the gypsum stack may impact routine operations on these roads, the implementation of this remedial action will need to be closely coordinated with ongoing operations and scheduled during a time when the impacts can be minimized. It is anticipated that implementation of this component will be completed within 180 days following the approval of this RDR/RAWP document. It is estimated that the remedial action will take approximately 2 to 3 weeks to complete.

4.2 Mobilization and Site Preparation

Following approval of the RDR/RAWP by the EPA a contractor will be selected to perform the removal activities. After selection of a contractor and award of the contract, mobilization and site preparation will begin. Upon receipt of notice to proceed by Simplot, the contractor will mobilize personnel, equipment and materials to the site. Prior to the initiation of activities, utilities in and around the work area will be located. Care will be taken to identify possible underground and overhead hazards. Portable sanitation facilities will be provided for on-site personnel at the work area. Simplot maintains access control to all areas of the Don Plant including the gypsum stack. Additional site security for the remedial action is not anticipated.

4.3 Road Grading

Prior to the placement of geotextile and gravel road base, the full width of the roadway barrier areas (approximately 12 feet) will be graded to remove loose material and create a smooth surface. The graded surface will be moisture conditioned through the application of water and compacted with a smooth drum or rubber-tired compactor a minimum of four passes, or until a stable subgrade is achieved. Only as much subgrade will be prepared in any given day as can be covered by barrier.

4.4 Placement of Geotextile and Road Base

Following completion of grading and subgrade preparation activities, as approved by the designated field supervisor (See Section 5.1), the non-woven geotextile will be placed on the road surface. The upper end of the fabric will be anchored in a shallow, six-inch, anchor trench to avoid slippage and adjoining geotextile rolls will be overlapped a minimum of one foot and sewn together using a j-stitch. The placement of gravel road base will begin at the bottom of the road and proceed uphill. Gravel road base shall be placed in loose lifts of approximately 7 to 8 inches (or as necessary to achieve a compacted thickness of 6-inches), moisture conditioned as necessary and compacted to at least 90 percent of the maximum dry density as determined by the Standard Proctor Density Test (ASTM D-698) at a moisture content within 2 percent of the optimum moisture content. Field density tests will be performed at a frequency of one test per 500 linear feet of roadway.

4.5 Environmental Controls

Dust control activities will be performed with the goal of minimizing dust emissions from the work site. Perimeter and excavation area watering will be utilized, as necessary, to control off-site migration of contaminants via wind dispersion. Haul roads will be wetted as necessary to control dust emissions. Wetting will be performed in a manner so as not to saturate the soils.

4.6 Site Restoration and Clean-up

Site restoration activities will be implemented upon completion of gravel placement operation. These activities will include restoring all staging areas to their pre-construction condition and removing all trash and debris from the site.

5.0 CONSTRUCTION MANAGEMENT PLAN

The implementation of the Gypsum Stack Roads remedial action will be conducted generally as described in Section 4.0 of this report. This section presents an overview of the construction inspection and management procedures including a brief discussion of project roles and responsibilities.

5.1 Management of Remedial Actions

The J.R. Simplot Company has overall responsibility for the completion of the Gypsum Stack Roads remedial action. Mr. Ward Wolleson of Simplot is the project manager and will act as the Remedial Action Coordinator for this work. In this role, Mr. Wolleson will be responsible for representing the interests of Simplot and ensuring that the project objectives are met within the framework of the Consent Decree and Statement of Work. MFG, Inc., on behalf of Simplot, is responsible for the development of the Remedial Design and Remedial Action planning. Simplot's representative on-site during construction will be Mr. Dale Reavis, P.E. The on-site representative will be responsible for overall supervision of the remedial action construction. Simplot will designate a field supervisor to perform day-to-day management of the remedial action construction activities. The field supervisor will be responsible for overseeing and documenting the contractor's operations, for documenting and performing visual observation, and ensuring the performance of all necessary quality control and quality assurance activities. The U.S. Environmental Protection Agency (EPA) is the lead agency on the project and will be providing oversight of the RD/RA activities including document review and acceptance and oversight of field activities, as necessary. Ms. Linda Meyer is EPA's Remedial Project Manager and primary EPA contact.

The objective of the construction management activities is to ensure compliance with the approved project plans. The detailed plan for completing the RA activities, or RA Work Plan, is presented in Section 4.0 of this document. Although no significant changes are envisioned, material changes in the scope of work or procedures for the implementation of the work may be necessitated by currently unforeseen conditions. If this occurs, change management procedures will be initiated to facilitate the modification to the RA program and gain EPA approval. Proposed or necessitated changes will be presented in writing to the EPA for review and approval. This change request will identify: the problem or situation that the change arose from; describe in detail the recommended change or modification suggested as a solution; and present an evaluation of the impact to the attainment of performance standards or schedule, if any. No deviations from the approved plans will proceed without approval of the EPA. Minor changes in the sequencing, site layout, or remediation procedures not in conflict with the intent of the project plans and specifications will be documented by the on-site representative and reported to the EPA's project manager, but will not require the initiation of formal change management procedures.

5.2 Quality Control and Quality Assurance

This section describes the general quality control and quality assurance procedures to be implemented by the construction management team to ensure compliance with the project performance requirements. Quality control refers to the procedures, methods and tests utilized by the construction contractor to achieve compliance with the plans and specifications, and quality assurance refers to the site inspection, checks and tests performed by the management team to ensure that the substantive requirements of the plans and specifications are met.

The primary quality control procedures to be utilized by the construction contractor include the use of adequately skilled personnel for the work being performed. The contractor will be required to submit information on all materials used for construction (i.e., non-woven geotextile material certifications, and gradations for the gravel road base) to confirm that the specifications are met. In addition, the contractor will be required to employ the services of an independent, third party subcontractor to perform quality control testing (compaction testing) for the road base. The Contractor will also be required to cooperate with the field supervisor in performing inspections and other quality assurance activities.

Quality Assurance procedures will primarily involve field inspections of the remediation project by the field supervisor. All procedures, materials, and equipment used in the construction will be observed and monitored by the field supervisor on a daily basis. The field supervisor will observe all quality control testing performed and will inspect the geotextile placement and the placement of the gravel road base to ensure that the minimum depth of six inches is achieved. Work elements that are not in compliance with the plans and specifications will be reworked by the contractor so that the element is in compliance. All material submittals and quality control data supplied by the contractor will be documented by the on-site representative to allow complete project tracking of all components of the construction.

5.3 Construction Reporting

The field supervisor responsible for overseeing the remedial action construction activities will keep a daily log, or complete a daily report, documenting the following information:

- Date;
- Weather conditions;
- Start and stop times;
- Names of people working and tasks performed by each;
- Work locations and quantities of materials placed;
- Location and results of all quality control tests; and
- Any other item the field supervisor feels is appropriate to include in the log.

In accordance with the requirements of the Consent Decree and Statement of Work, monthly progress reports will be submitted to the EPA to provide a status of activities being conducted within the Simplot Plant Area. A section of this report will be dedicated to reporting on the progress of Gypsum Stack Roads activities, as appropriate.

Upon substantial completion of the Gypsum Stack Roads remedial activities, the EPA will be notified for the purpose of conducting a Prefinal Construction Inspection, which will consist of a walk-through inspection. If outstanding construction items are discovered during the inspection, a Prefinal Construction Inspection Report will be submitted, including details of outstanding construction items, actions performed to resolve the items, completion date and an anticipated date for the final inspection. The final construction inspection will evaluate items identified in the prefinal inspection. Within 30 days of the Final Construction Inspection, a Construction Completion Report will be submitted. This report will include descriptions of the remedial activities, field records and as-built drawings. This report will include a description of the project organization, the construction sequence, equipment and personnel used during remedial activities, a description of design changes/field changes/change orders, a summary of all QA/QC testing, surveying and final project quantities. The final as-built drawings and certification report will be signed and stamped by an Idaho-registered Professional Engineer.

5.4 Construction Health and Safety Control

A Construction Health and Safety Plan will be prepared and submitted to the EPA under separate cover. This plan will detail the minimum health and safety requirements to be adhered to during the performance of remedial action activities. The construction contractor will be responsible for the health and safety of their construction crews and personnel during on-site activities. The Simplot on-site representative will be responsible for providing guidance and inspection to ensure that proper procedures are followed for health and safety of the public and visitors to the site during construction activities.

6.0 OPERATION AND MAINTENANCE

This section specifies the inspection and maintenance procedures that will be followed to ensure the integrity of the gravel road surfacing. Inspection of the road barriers will be performed semi-annually when the ground is not snow covered. An inspector will drive the roads and visually determine the condition of the gravel surfacing and assess its ability to continue to fulfill its intended objective of reducing dust emissions. Conditions that will be evaluated include erosion or displacement of the gravel surface that may expose the geotextile fabric and/or the gypsum surface, or intrusion of gypsum onto the surface of the road. Any erosion or other damage that either exposes underlying gypsum or results in gypsum on the driving surface will be repaired through grading operations and/or the placement of additional gravel road base.

7.0 REFERENCES

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TABLES

TABLES

Table 1
Summary of Gypsum Stack Area Roads and Traffic Loads

				Traffic Load				
Area	Road	Type	Base Material	Equipment Type	Trip Frequency	Approx. Weight (lbs)	Ground Pressure (psi)	Tread
East Side	East Access Road (Above East Face Road)	Permanent	Native Soil[4]	Pick-up Truck	3 per day	5,500	35	Tires
				Dump Truck	2 per week	50,000	100	Tires
	East Access Road (Below East Face Road)	Permanent	Primarily Native Soil [1,4]	Pick-up Truck	9 per day	5,500	35	Tires
				Dump Truck	2 per week	50,000	100	Tires
				Fuel Truck	1 per week	24,500	100	Tires
	East Face Road	Permanent	Gypsum	Pick-up Truck	6 per day	5,500	35	Tires
				Fuel Truck	1 per week	24,500	100	Tires
	Off-Site Roads	Permanent	Native Soil[4]	Pick-up Truck	1 per month	5,500	35	Tires
West Side	West Access Road	Permanent	Native Soil[4]	Pick-up Truck	16 per day	5,500	35	Tires
	West Face Road	Permanent	Gypsum	Pick-up Truck	16 per day	5,500	35	Tires
				Fuel Truck	1 per day	24,500	100	Tires
				Dozer	2 per month	29,000	7	Tracks
				Excavator	4 per year	59,000/119,000	7.7/13.3	Tracks
				Truck w/ Trailer	2 per year	15,000	35	Tires
	Pipeline Access Road #1	Temporary [2]	Gypsum	Truck w/ Trailer	2 per year	15,000	35	Tires
	Pipeline Access Road #2	Temporary [2]	Gypsum	Pick-up Truck	3 per day	5,500	35	Tires
				Fuel Truck	1 per day	24,500	100	Tires
				Dozer	2 per week	29,000	7	Tracks
				Excavator	2 per week	59,000/119,000	7.7/13.3	Tracks
Top Berms	East, Center & West	Temporary[3]	Gypsum	Dozer	Continuous	29,000	7	Tracks
				Excavator	Continuous	59,000/119,000	7.7/13.3	Tracks

Notes:
[1] Lower portion of the East Access Road is founded on native soil except for approximately 1,200 lf crossing of lower gypsum stack.
[2] *Pipeline Access Road #1 to be abandonded in 5 to 10 years. Pipeline Access Road #2* to be abandoned in 2 to 4 years.
[3] Berm roads are constantly being covered by subsequent lifts during berm construction.
[4] Roads constructed on native soil are not subject to remedial action.

Table 2
Minimum Requirements for Geotextile Material

Parameter	Test Method	Minimum Requirement
Burst Resistance	ASTM D3786	1,300 kPa
Tensile Strength	ASTM D4632	170 N
Puncture Resistance	ASTM D4833	375 N

Table 3
Cost Analysis - Gravel Road Base

Gyspum Stack Roads RDR
Eastern Michaud Flats Superfund Site - Simplot Plant Area

	Unit	Est Qty	Unit Rate	Amount
Capital/Installation Costs				
Materials				
Gravel (Delivered)	tons	1800	$8.00	$14,400
Non-woven fabric	sy	5600	$1.50	$8,400
Placement				
Foreman	hr	95	$50.00	$4,750
Laborer	hr	95	$35.00	$3,325
Dozer (D7)	hr	85	$105.00	$8,925
Motor Grader	*hr*	*95*	*$115.00*	*$10,925*
Compactor	hr	85	$85.00	$7,225
Installation Subtotal				**$57,950**
Contingency	20%			$11,590
Total Capital/Installation Costs				**$69,540**
Annual Maintenance Costs				
Materials				
Gravel (Delivered)	tons	340	$8.00	$2,720
Placement				
Foreman	hr	12	$50.00	$600
Dozer (D7)	hr	12	$105.00	$1,260
Motor Grader	hr	18	$115.00	$2,070
Compactor	hr	12	$85.00	$1,020
Total Annual Maint Costs:				**$7,670**

Notes:
1. Gravel quantities are based on 3700 feet of 12 foot wide road with 6 inches of gravel (600 cy = 1050 tons)
2. Twenty-five percent has been added to the estimated gravel qty for compaction.
3. Gravel road base costs are based on $4/ton at the pit plus 5% tax.
4. Delivery costs are based on using ten-wheel (12 cy/15 ton) end dumps making one trip per hour at $55 per hour. 2 trucks would be capable of delivering 240 tons/day
5. Unit rates for all equipment include operator. Costs are based on the assumption that trucks will be able to dump on the road. If loader is required to tram material, costs will increase.

Table 4
Cost Analysis - Water Truck Operation

Gyspum Stack Roads RDR
Eastern Michaud Flats Superfund Site - Simplot Plant Area

	Unit	Est Qty	Unit Rate	Total
Operating Costs				
Truck Operating Cost ($/hr)	hr	1092	$26	$28,086
Labor (Driver)	hr	1092	$24	$25,990
Annual Operating Costs				**$54,076**
Capital Costs - Truck Purchase				
Used Truck - 1986 GMC 2,000 gal				$23,500
Used Truck - 1993 Volvo 2,500 gal				$29,500
Used Truck - 1994 Mack 4,000 gal				$43,500
New Truck - 2002 GMC 4,000 gal				$100,000

Notes:
1. Operating costs are based on 1994 *Rental Rate Blue Book* costs of $20.30 escalated 3% per year for 8 years.
2. Operating costs include fuel, oil, tires, and routine maintenance and repair (Based on relatively new equipment).
3. Operating costs do not include major overhaul costs or ownership costs such as depreciation.
4. Labor costs for the water truck are based on $17 per hour with a multiplier of 1.4 for fringe.
5. Assumes operation 6 hrs/day, 7 days/wk, 26 weeks/yr

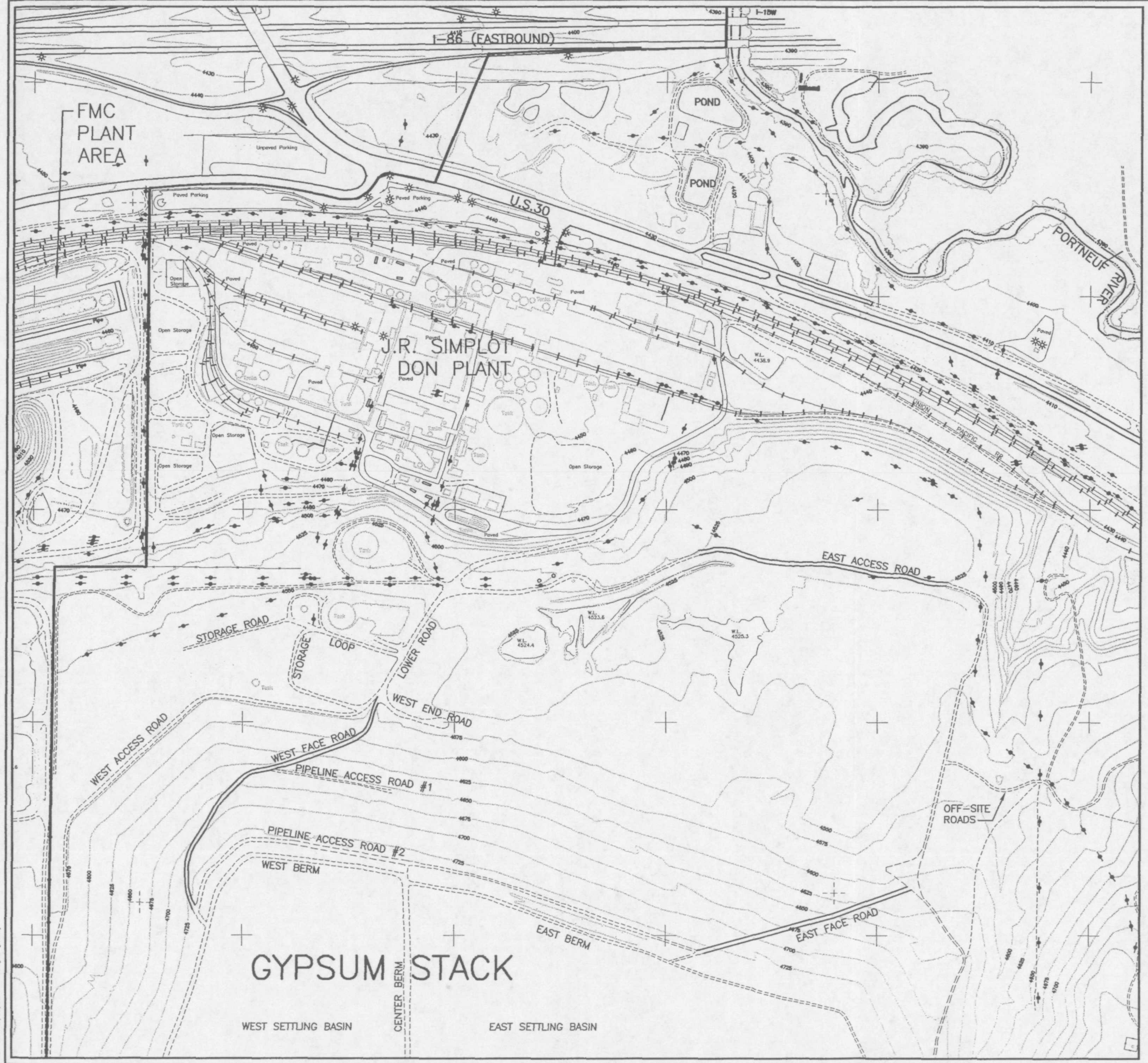
Table 5
Acceptable Geotextile Materials [1]

		Mullen Burst ASTM D-3786	Grab Tensile ASTM D-4632	Puncture ASTM D-4833
Minimum Requirements		1,300 kPa	170 N	375 N
Product Name	Mass per Unit Area	Manufacturer's Listed Minimum Average Roll Value		
Amoco 4506	6 oz/yd^2	2,135 kPa	710 N	400 N
Amoco 4508	8 oz/yd^2	2,619 kPa	900 N	575 N

[1] Approved Equivilent Materials will also be acceptable.

FIGURES

FIGURES



LEGEND:

PERMANENT ROADS FOUNDED ON GYPSUM

N

SCALE

500 0 500 FEET

SIMPLOT PLANT AREA
EASTERN MICHAUD FLATS
SUPERFUND SITE
POCATELLO, IDAHO

STACK ROADS REMEDIAL DESIGN REPORT

FIGURE 1

LAYOUT OF ROADS NEAR AND ON GYPSUM STACK

PROJECT: 010121.2	DATE: APRIL 2002	
REV:	BY: SCG	CHECKED: ACK

MFG, Inc.
consulting scientists and engineers

APPENDIX A

APPENDIX A

Preliminary Stack Geotechnical Data

January 25, 2001
File Number 98-125

J.R. Simplot Company
Minerals & Chemicals Division
P.O. Box 912
Pocatello, Idaho

Attention: Mr. Dale Reavis

Subject: Preliminary Results of Laboratory Materials Testing of Uncalcined Gypsum Deposits Compared to Test Results of the Older Calcined Deposits, Gypsum Disposal Field, Pocatello, Idaho

Dear Mr. Reavis

As requested, I am attaching a draft summary of laboratory test results completed to date on the above referenced project. The work was originally commissioned by Mr. Paul Aschenbrenner, with the primary objective of defining drainage and strength characteristics of the new uncalcined byproduct gypsum currently being produced at the Pocatello facility relative to the older and previously tested gypsum deposits in the lower portion of the gypsum stack that were produced using calcined ore.

The results of the laboratory testing completed to date and our preliminary assessment and characterization of the uncalcined gypsum material properties are contained in this draft report. In general, the results of the laboratory testing program indicate that the uncalcined gypsum appears to have a much lower coefficient of permeability, low density and greater insitu moisture content than the older gypsum deposits tested in 1992. In addition, consolidated undrained triaxial shear strength tests performed on undisturbed samples of the uncalcined gypsum indicated that positive pore water pressures were developed in all of the samples during shear (i.e., unlike the older gypsum deposits that tend to developed negative pore water pressures during shear), making the new gypsum product potentially more susceptible to liquefaction.

Most conventional gypsums develop negative pore pressures during shear and are typically not subject to liquefactions. Our original proposal called for a simple qualitative comparison of the liquefaction potential of the uncalcined gypsum with a more conventional gypsum using shaking table tests, wherein samples of both gypsums would be remolded to different densities and moisture contents and shaken at increasing magnitudes/amplitudes as needed to initiate laboratory liquefaction. The results of these tests (although not included in this preliminary report) indicated the uncalcined gypsum was actually less susceptible to liquefaction than the conventional gypsum used in the relative comparison. These results, however, are intuitively inconsistent with the results of the triaxial shear tests which indicated positive pore pressures during shear, with a greater potential for liquefaction.

Since the uncalcined gypsum samples received in our laboratory appear to have some cohesion at the very low densities that we typically do not see in the more conventional gypsums (possibly as a result of the higher organic content present in the uncalcined product), it was our opinion the shaking table results might not be a true indication of relative liquefaction potential. In that regard, we have undertaken to perform cyclic loading tests on samples of your uncalcined gypsum that better model conditions that would actually occur during seismic loading conditions. As previously discussed, the cyclic loading tests performed on undisturbed samples obtained from depths greater than 10 feet indicate that the uncalcined gypsum at the densities tested is generally not subject to liquefaction under the maximum seismic loading conditions expected for your region of the country.

We are in the process of testing additional samples at much lower densities that will better represent conditions in the uppermost portion of the gypsum stack. This additional testing, which will be performed on remolded samples sedimented into the test device to achieve very low densities, is not yet complete.

I hope that this preliminary summary of testing completed to dat will meet your immediate needs. Please give me a call and we can discuss any aspects of the report that are not clear.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

Bill E. Jackson, P.E.
Senior Project Engineer

BEJ:bej:jo

C:\MyFiles\BEJ\98-125 SIMPLOT Seep Rev.001.wpd gypsum, $CaSO_4 \cdot 2H_2O$, has two molecules of water attached) in the high temperature oven used in ignition-type determinations. The results of the organic content tests are tabulated below. As noted, organic content values varied from a low of 1.0% to a high of 7.5%, with average values in the range of 3.8 to 4.3%, for test location TH-4 and TH-5, respectively. The organic content of both filter cake samples was 6.2%.

Sample No.	Depth (feet)	Organic Content (%)*
TH-4, US-1	10 -12.5	1.9
US-2	20 - 22.5	1.0
US-3	30 - 32.5	4.8
US-4	40 - 42.5	6.6
US-5	50 - 52.5	5.6
Average =		3.8
TH-5, US-1	10 -12.5	1.8
US-2	20 - 22.5	1.0
US-3	30 - 32.5	5.9
US-4	40 - 42.5	7.5
US-5	50 - 52.5	5.4
Average =		4.3
BF#1	N/A	6.2
BF#2		6.2

* Based on AASHTO T 194 wet combustion method.

The organic content test results from boring locations TH-4 and TH-5 are also plotted as a function of depth on Figure 2. It is noteworthy that the organic content varies significantly and consistently with depth at the two remote testing locations. In particular, the lowest values in both test holes occur at a depth of about 20 feet, with the highest values occurring at a depth of about 40 feet. The results of permeability tests (discussed in Section 3.9 fo this report) indicate that the vertical hydraulic conductivity of the uncalcined gypsum may vary partially as a function of organic content. The observed variation in organic content with depth shown on Figure 2, therefore, may represent a distinct layered system relative to hydraulic conductivity and drainage characteristics. The significance of these findings are discussed in greater detail in Section 4.0 of this report.

3.4 Gypsum Content

Selected samples of the uncalcined gypsum were dried at oven temperatures of 40°C and 200°C to determine the change in sample weight resulting from an associated loss of the chemically bonded water of hydration in the gypsum (i.e., gypsum, $CaSO_4 \cdot 2H_2O$ converts to $CaSO_4$) at the higher drying temperature. The change in apparent moisture content can be used to determine the relative purity of the gypsum (i.e., the weight of any non-gypsum particles will not change as a result of the higher drying temperature). The theoretical change in sample weight expected for dihydrate calcium sulfate (gypsum) is 20.9% (i.e., the molecular weight ratio of $(2H_2O)/(CaSO_4 \cdot 2H_2O)$). The results are tabulated below:

Sample No.	Moisture Content, w_c* (%)		Δw_c** (%)	Non-Gypsum Component (%)	Gypsum Component (%)
	40°C	200°C			
TH-4, US-1	40.8	60.5	19.7	5.7	94.3
TH-4, US-2	50.5	70.2	19.7	5.7	94.3
TH-4, US-3	31.1	50.1	19.0	9.0	91.0
TH-4, US-4	52.1	72.3	20.2	3.3	96.7
TH-5, US-1	38.7	57.8	19.1	8.6	91.4
TH-5, US-2	57.4	76.3	18.9	9.5	90.5
TH-5, US-3	49.3	68.6	19.2	8.1	91.9
TH-5, US-4	47.9	66.5	18.6	10.9	89.1
TH-5, US-5	36.1	55.4	19.3	7.6	92.4

* Where moisture content was calculated using the ratio of weight of water at the drying temperature to the weight of dry solids at 40°C.
** $\Delta w_c = w_c(200°C)-w_c(40°C)$

Similar test were also performed on four sample of the older gypsum deposits recovered during the 1992 sampling program. The gypsum component for the 1992 samples varied from a low of 92.2% to a high of 93.7%. A composite sample of the uncalcined gypsum taken from portions of the five undisturbed samples obtained from boring location TH-5 was also sent to Pembroke Laboratories, Inc. in Fort Meade, Florida for further analyses and documentation of sample composition. The composite sample contained 0.84% P_2O_5, 1.83% $Ca_3(PO_4)_2$, and 6.35% acid insoluble materials, for a total non-gypsum component of 9%.

3.5 Particle Size Distributions

Grain size determinations were conducted on select samples of the uncalcined gypsum using ASTM Testing Method D-422, "Particle Size Analysis of Soils,", using wet sieve procedures for the fraction greater than 0.074 mm (No. 200 sieve size) and hydrometer test procedures for the finer materials. All tests were performed using gypsum saturated water and an oven drying temperature of 40°C. The results of the individual grain size distribution curves generated from these tests are presented graphically in Appendix 1, and also summarized on Figure 3.

As noted on Figure 3, the gradation curves for the J.R. Simplot uncalcined gypsum generally fall within the typical range of values from other phosphogypsums in the industry, but tend to plot on the finer side of the typical range of values. The belt filter samples are the most representative of the true grain size distribution of the J.R. Simplot gypsum, and should generally contain all particle sizes prior to natural segregation that occurs in the settling ponds. When gypsum slurry is discharged into a settling pond on top of the stack, the larger particle sizes contained in the slurry tend to settle more quickly, resulting in coarser particle sizes near the slurry discharge location and finer particle sizes at more remote locations from the discharge. This condition is clearly illustrated on Figure 3, where it can be seen that the grain size distribution curves for the insitu samples are generally finer than the belt filter samples.

Figure 4 is a comparison of the gradation curves for the uncalcined gypsum with the range of values for samples of the older gypsum deposits obtained in 1992 from borings TH-1 and TH-2. As noted, the gradation curves for the uncalcined gypsum are generally within the range of the older gypsum deposits, although somewhat finer. A summary of laboratory index properties for the J.R. Simplot uncalcined gypsum is presented in Table 1.

3.6 In-Place Density and Moisture Content

Unit weights, or in-place densities, were determined for all of the undisturbed Shelby tube samples of uncalcined gypsum recovered from boring locations TH-4 and TH-5. The total weight and volume of soil within each tube was measured in the laboratory and used to calculate an average total density. The respective dry density was then calculated from the respective total density using an average of several natural moisture contents taken from each sample tube. The results of these tests are summarized in Table 2. Also shown on Tables 3 and 4 are the results of similar testing performed on undisturbed sample of the older gypsum deposits recovered during the 1992 testing program. Four of the samples obtained in the 1992 sampling program were hand-pushed Shelby tube samples of the near-surface deposits recovered from the south ends of the east and west settling compartments (i.e., samples HP-1E, HP-2E, HP-1W and HP-2W). As it is our understanding that utilization of the uncalcined ore began prior to the 1992 sampling program, these samples may be uncalcined byproduct gypsum.

Figure 5 presents the *in situ* dry density of the J.R. Simplot gypsum as a function of depth. Disregarding the abnormally high densities in the upper 30 to 40 feet of the older test data that has most likely been influenced by surface compaction, the majority of the data falls within a band defined by the average relationship given by:

$$\gamma_d = 63.0 + 0.26(Z) \qquad (\pm 5 \text{ pcf})$$

where γ_d is the dry density expressed in units of pounds per cubic foot (pcf) and Z is depth below the ground surface, in feet. The measured densities of the uncalcined gypsum, however, are generally somewhat lower than the average relationship, most likely due to the presence of organic materials and the lower specific gravities discussed above. The *in situ* dry density of the uncalcined gypsum deposits can best be characterized by the following relationship:

$$\gamma_d = 60.0 + 0.26(Z) \qquad (\pm 5 \text{ pcf})$$

Figure 6 is a comparison of the J.R. Simplot gypsum dry density versus depth profile with other phosphogypsums in the industry. As noted, the J.R. Simplot dry density data falls within the full range of the other data, but is somewhat lower than the industry average.

Figure 7 is a plot of average *in situ* moisture content as a function of depth comparing the 1992 samples and the current samples of uncalcined gypsum. Also shown on this figure is the theoretical saturated moisture content (i.e., 100% saturation, where all pore spaces are completely filled with water, with no entrained air). As can be seen, the *in situ* moisture content of the uncalcined gypsum deposits, at any given depth, is generally greater than that of the pre-1992 samples. The moisture content of the sedimented gypsum deposits should generally decrease with depth, reflecting the increase in density with depth discussed above.

gypsum as a function of time. The vertical and lateral extent of this layering are unknown and beyond the scope of this study.

3.10 Shear Strength

Six consolidated-undrained triaxial shear strength tests were performed on undisturbed samples of the uncalcined gypsum recovered during the recent sampling program to determine the material shear strength and pore pressure response during shear. The results of these tests were compared to test results performed on undisturbed samples of the older gypsum deposits recovered during the 1992 sampling program.

All undisturbed samples were tested at their *in situ* densities using strain-controlled, consolidated-undrained $\overline{CU}$ triaxial shear tests with pore pressure measurements. All samples were consolidated under a back pressure of not less than 6 kg/cm^2 with gypsum saturated water to achieve sample saturation prior to shear. The consolidated samples were sheared at a rate slow enough to allow for pore pressure equilibration and measurement with a rigid, flush-diaphragm pressure transducer. During shear, the axial load, vertical strain, cell pressure and pore pressure were continuously monitored and electronically recorded via an automated data acquisition system. All shear strength testing was conducted in general accordance with the procedures outlined in ASTM D 4767.

Table 8 presents a summary of the initial and pre-shear (i.e., post-consolidation) conditions of each sample prior to testing. Initial and pre-shear parameters monitored include moisture content, dry density, degree of saturation and void ratio. The final test results are summarized in Table 9 for Mohr-Coulomb (maximum ratio of major principal stress divided by minor principal stress) and Ultimate (large strain values taken at end of test) failure criteria.

The effective stress paths and plots of normalized principal stress difference, excess pore pressure and obliquity (major principal stress divided by minor principal stress) versus axial strain for each shear strength tests are presented in Appendix 2.

The effective stress paths and effective stress-strength envelopes (K_f envelopes) for various combinations of the shear strength tests are also presented as "p" versus "q" plots in Figures 12 through 15 (for $p = 1/2(\sigma_1 + \sigma_3)$ and $q = 1/2(\sigma_1 - \sigma_3)$, where σ_1 and σ_3 are the major and minor principal effective stresses).

Figure 12 presents the results of three tests performed on undisturbed samples recovered from a depth of 20 feet. Two of these tests are on uncalcined gypsum samples obtained during the recent sampling program and the remaining test is on a sample of the older gypsum deposits obtained during the 1992 sampling program. As can be seen from Figure 12, the peak shear strength of the uncalcined gypsum is slightly greater than the previously measured value for the older gypsum deposits. The average effective angle of shearing resistance for the uncalcined gypsum is approximately 56°, with zero effective cohesion, while the measured strength on the pre-1992 sample is approximately 51° friction, with zero cohesion. The lower bound, ultimate or residual strength measured at large strains for all three tests was about 46° friction, with zero cohesion.

Figure 13 presents the results of shear strength tests performed on samples of the uncalcined gypsum deposits obtained from the depth range of 40 to 50 feet. As noted, the range of measured strength values varied from an upper bound effective friction angle of 62°, with 0.45 kg/cm^2 effective cohesion, to a lower bound ultimate strength of 48° friction, with zero effective cohesion.

The results of previously performed triaxial shear strength tests on three undisturbed samples of the older and deeper gypsum deposits recovered during the 1992 study are presented in Figure 14. These samples were obtained from depths of 60, 100 and 120 feet below the gypsum stack top surface that existed at that time (i.e., top of upper stack was near Elevation 4720 feet, MSL, at the time of sampling in 1992). All of these samples exhibit very high strengths with cohesive intercepts that are characteristic of varying degrees of cementation.

Shear strength test performed on the two hand pushed samples (HP-1 and HP-2) taken from the back of the pond surface during the 1992 study gave quite different results. As noted on Figure 15 and the detailed test results presented in Appendix 2, Sample HP-1, taken from the east pond, exhibited a relatively high strength (effective friction angle of 60°, with zero cohesion) but developed and sustained positive excess pore pressures during shear. As it is our understanding that the production of uncalcined gypsum commenced prior to the 1992 sampling program, it is very likely that this near-surface sample is comprised of gypsum produced from uncalcined ore. Sample HP-2, taken from the back side of the west pond, indicated a lower material strength (effective friction angle of 44°, with zero cohesion) with a less positive excess pore pressure response that dissipated to a negative values by the end of the test. It is not clear whether this sample was comprised of uncalcined or calcined gypsum.

3.11 Pore Pressure Response During Shear

Another important observation when comparing the test results of the uncalcined gypsum with the pre-1992 gypsum is the pore pressure response during sample shear. In reference to the graph of "Excess Pore Pressure, Δu(kg/cm^2)" presented on the individual test results in Appendix 2, it can be noted that all of the tests performed on the uncalcined gypsum samples developed positive pore pressures during shear, which remained positive and relatively constant throughout the test with very little dissipation. The pre-1992 samples, on the other hand, initially developed small positive pore pressures at low strains, followed, in most cases, by the development of negative pore pressures with continued shear and larger strains near the end of the test. The generation of negative pore pressures during shear is normally referred to as "dilation", which, as will be discussed below, is desirable since the negative pore pressures will increase effective stresses and strength during shear. The two hand pushed samples (HP-1 and HP-2) from the 1992 study, which are assumed to be uncalcined gypsum, gave conflicting results relative to pore pressure development during shear.

In soil mechanics, the strength, or shearing resistance, τ, of a cohesionless soil (gypsum in this case) is a function of the materials angle of internal friction, ϕ, and the effective stress, $\bar{\sigma}$, applied normal to the failure plane (i.e., $\tau = \bar{\sigma} \tan \phi$), where effective stress is defined as the total stress, σ, minus the pore water pressures, u, (i.e., $\bar{\sigma} = \sigma - u$). The generation of positive pore pressures during shear, therefore, will result in a lower effective stress and less shearing resistance along the failure plane. The generation of negative pore pressures during shear has exactly the opposite effect, increasing the effective stress and associated shearing resistance (i.e., strength).

J.R. Simplot Company
File Number 98-125

Table 1

SUMMARY OF LABORATORY INDEX PROPERTIES FOR J.R. SIMPLOT UNCALCINED PHOSPHOGYPSUM

Boring No. or Sample Type	Sample	Sample Depth (feet)	w_{40} (%)	w_{200} (%)	Dwç (%)	Estimated Non-Gypsum Component (dry wt, %)	Organic Content (%)	Acid Insoluble (%)	Particle-Size		
									-75mm (%)	-5mm (%)	d_{50} (mm)
TH-4	10-12.5	10-12.5	40.8	60.5	19.7	5.7	1.9	-	92.7	1.7	25
TH-4	20-22.5	20-22.5	50.5	70.2	19.7	5.7	1.0	-	93.5	4.9	25
TH-4	30-32.5	30-32.5	31.1	50.1	19.0	9.0	4.8	-	99.8	7.6	20
TH-4	40-42.5	40-42.5	52.1	72.3	20.2	3.3	6.6	-	97.1	4.0	24
TH-4	50-52.5	50-52.5	-	-	-	-	5.6	-	96.4	4.0	28
TH-5	10-12.5	10-12.5	38.7	57.8	19.1	8.6	1.8	-	97.6	3.6	24
TH-5	20-22.5	20-22.5	57.4	76.3	18.9	9.5	1.0	-	99.8	3.4	20
TH-5	30-32.5	30-32.5	49.3	68.6	19.2	8.1	5.9	-	89.4	1.8	35
TH-5	40-42.5	40-42.5	47.9	66.5	18.6	10.9	7.5	-	93.9	2.0	30
TH-5	50-52.5	50-52.5	36.1	55.4	19.3	7.6	5.4	-	98.5	5.6	18
TH-5	Composite	-	36.5	56.0	19.5	6.6	-	6.35	-	-	-
Belt Filter	1	-	67.4	86.4	19.0	9.0	6.2	-	84.3	4.6	34
Belt Filter	2	-	58.3	-	-	-	6.2	-	95.2	3.7	35
Bucket	1	-	78.3	96.6	18.3	12.4	-	-	96.7	1.9	25
Bucket	2	-	77.6	96.0	18.4	11.9	-	-	91.2	4.0	30
Bucket	3	-	89.3	102.2	12.9	38.2	-	-	92.9	0.0	29

Where: w_{40} = Moisture content at oven drying temperature of 40°C; w_{200} = Moisture content at oven drying temperature of 200°C; $\Delta w_c = (w_{200}-w_{40})$; -75 µm and -5 µm = Solids fractions by dry weight finer than 75 µm (U.S. Standard No. 200 sieve) and 5 µm, respectively; and d_{50} = Mean Particle-Siz Gypsum content, GC, calculated assuming only gypsum ($CaSO_4 \cdot 2H_2O$) and non-hydrated minerals (i.e., apatite, silica) are present: GC = (4.7

PMC 98-125 Tables.wpd

Table 8

SUMMARY OF PRE-SHEAR PROPERTIES OF STRENGTH TEST SAMPLES OF J.R. SIMPLOT PHOSPHOGYPSUM

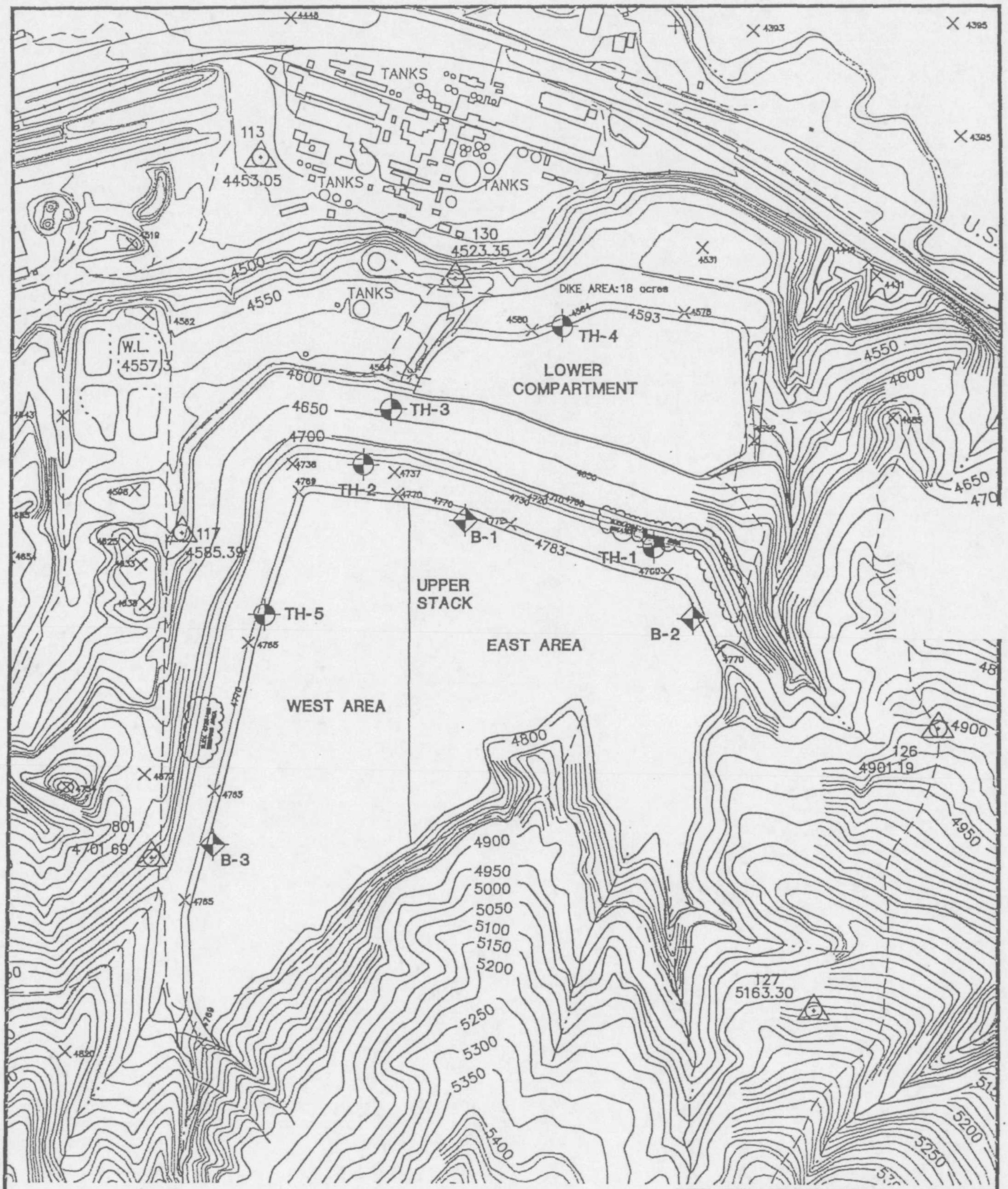
Description	Test Hole No.	Sample No.	Sample Depth (ft)	Full Tube Dry Density (lb/ft^3)	Prior to Testing				Prior to Shear				
					Total Density (lb/ft^3)	Moisture Content (%)	Dry Density (lb/ft^3)	Saturation (%)	σ' (kg/cm^2)	Back Pressure (kg/cm^2)	B Factor (%)	Moisture Content (%)	Dry Density (lb/ft^3)
Uncalcined Gypsum (2000)	TH-5	US-2	20.0 - 22.5	62.7	94.0	65.5	56.8	97.8	0.5	12.0	99.0	61.2	59.9
	TH-5	US-2	20.0 - 22.5	62.7	103.5	44.0	71.9	100.0	1.5	12.0	96.0	39.7	75.5
	TH-5	US-4	40.0 - 42.5	66.6	101.5	49.0	68.1	100.0	0.7	12.0	97.0	47.6	68.9
	TH-5	US-5	50.0 - 52.5	72.2	97.6	44.8	67.4	90.2	1.4	12.0	97.0	43.4	72.3
	TH-5	US-5	50.0 - 52.5	72.2	105.0	38.5	75.8	97.6	2.8	11.0	89.0	35.0	80.1
	TH-4	US-5	50.0 - 52.5	72.2	103.3	37.9	74.9	93.8	6.0	6.0	95.0	30.3	85.3
Pre-1992 Gypsum	TH-1	PS-6	60.0 - 62.5	78.1	106.6	30.0	82.0	90.4	1.0	12.0	93.0	32.7	82.5
	TH-1	PS-10	100.0 - 102.5	88.3	105.4	25.2	84.2	80.9	2.0	12.0	92.0	30.9	84.5
	TH-1	PS-11	120.0 - 122.5	93.9	116.6	21.5	96.0	97.4	3.0	11.0	99.9	22.9	94.8
	TH-2	PS-2	20.0 - 22.5	72.0	93.6	30.9	71.5	69.7	0.5	12.0	98.0	42.5	73.1
Exposed Gypsum at Pond Surface (Pre-1992)	Hand Pushed	HP-1	1.0 - 2.0	-	90.6	73.6	52.2	96.1	1.0	12.0	99.0	61.0	60.0
	Hand Pushed	HP-2	1.0 - 2.0	-	97.1	47.3	65.9	91.4	0.5	12.0	99.7	43.7	72.0

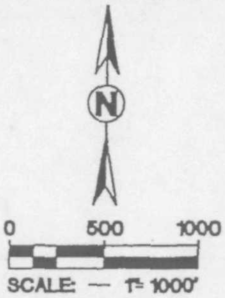
J.R. Simplot Company
File Number 98-125

Table 9

SUMMARY OF UNDRAINED TRIAXIAL TEST RESULTS ON UNDISTURBED SAMPLES OF J.R. SIMPLOT PHOSPHOGYPSUM

Description	σ'_o (kg/cm^2)	At Mohr-Coulomb Failure							At Ultimate						
		ε (%)	$\frac{1}{2}(\sigma'_1+\sigma'_3)$ (kg/cm^2)	$\frac{1}{2}(\sigma'_1-\sigma'_3)$ (kg/cm^2)	ΔU (kg/cm^2)	A Factor	σ'_1/σ'_3	φ' for $c' = 0$	ε (%)	$\frac{1}{2}(\sigma'_1+\sigma'_3)$ (kg/cm^2)	$\frac{1}{2}(\sigma'_1-\sigma'_3)$ (kg/cm^2)	ΔU (kg/cm^2)	A Factor	σ'_1/σ'_3	φ' for $c' = 0$
Uncalcined Gypsum (2000)	0.5	2.2	0.75	0.64	0.39	0.30	12.52	58.5	16.9	0.80	0.63	0.33	0.26	8.61	52.3
	1.5	1.7	1.73	1.44	1.21	0.42	10.79	56.3	17.1	2.02	1.47	0.95	0.32	6.36	46.7
	0.7	3.9	1.99	1.97	0.68	0.17	176.54	81.3	16.2	1.71	1.52	0.52	0.17	17.45	63.1
	1.4	1.6	2.13	1.82	1.09	0.30	12.73	58.7	16.5	1.66	1.26	1.00	0.40	7.36	49.4
	2.8	6.1	3.15	3.04	2.69	0.44	53.25	74.8	18.8	3.33	2.93	2.41	0.41	15.83	61.6
	6.0	14.9	7.39	5.56	4.17	0.38	7.08	48.8	17.2	7.26	5.46	4.19	0.38	7.03	48.8
Pre-1992 Gypsum	1.0	0.84	6.72	6.57	0.85	0.06	87.34	77.8	18.3	9.95	7.58	-1.32	-0.09	7.37	49.6
	2.0	0.46	10.53	9.95	1.42	0.07	35.27	70.9	16.9	11.13	8.46	-0.70	-0.04	7.31	49.5
	3.0	4.30	22.79	22.58	2.80	0.06	216.52	82.2	13.0	25.61	21.86	-0.75	-0.02	12.66	58.6
	0.5	0.51	1.92	1.50	0.08	0.03	8.14	51.4	17.2	2.23	1.64	-0.05	-0.02	6.49	47.3
Exposed Gypsum at Pond Surface (Pre-1992)	1.0	19.3	0.91	0.79	0.92	0.58	14.14	60.2	19.9	0.92	0.80	0.91	0.57	13.68	60.4
	0.5	12.8	1.58	1.11	0.04	0.02	5.67	44.6	23.2	1.89	1.30	-0.04	-0.02	5.43	43.7





LEGEND

TH-1 BORING LOCATION

B-2 BULK SAMPLE LOCATION

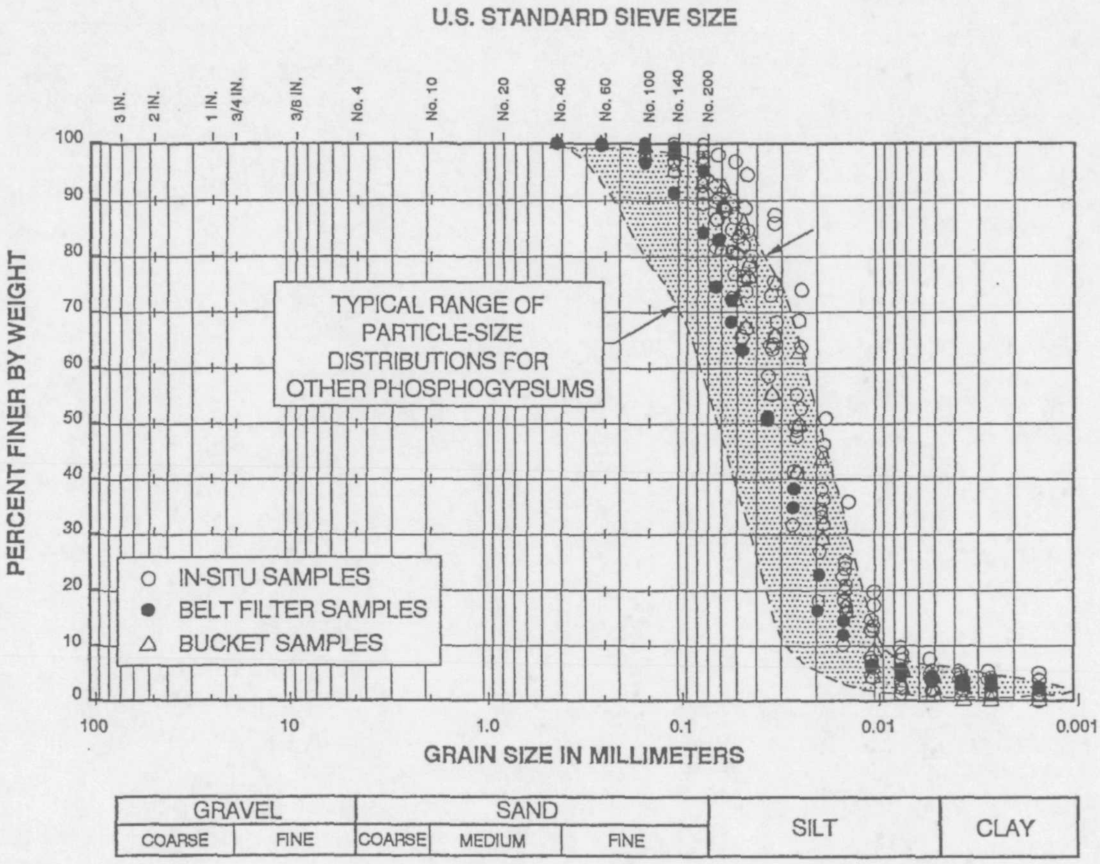
SITE AND
BORING LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

EXISTING GYPSUM STACK
J.R. SIMPLOT COMPANY
POCATELLO, IDAHO

DRAWN BY: CSS	CHECKED BY:	DATE: 07/07/00
FILE NO. 98-125	APPROVED BY:	FIGURE: 1

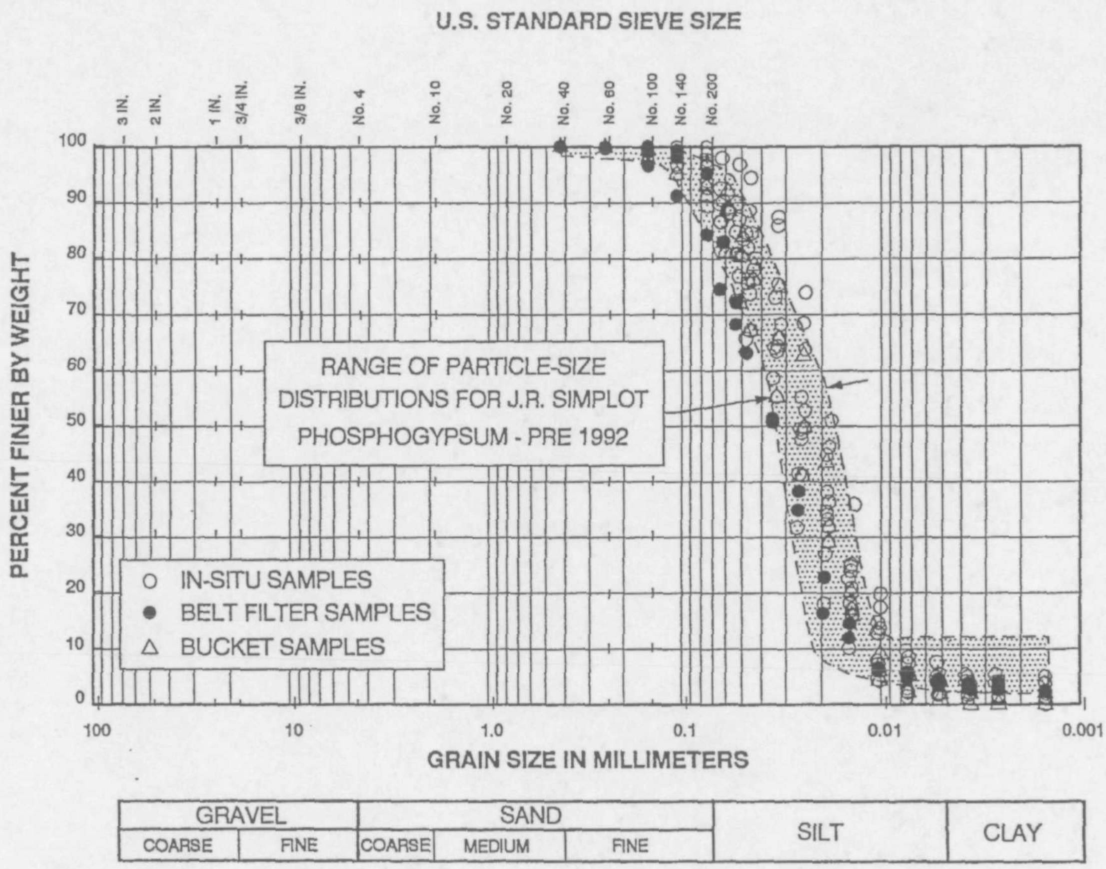
CADD FILE: 98125-2.DWG 01/09/01 SR



PARTICLE-SIZE DISTRIBUTION OF J.R. SIMPLOT UNCALCINED PHOSPHOGYPSUM

FIGURE 3

GYPSIZE.DRW



PARTICLE-SIZE DISTRIBUTION OF J.R. SIMPLOT UNCALCINED PHOSPHOGYPSUM RELATIVE TO OLDER (PRE-1992) DEPOSITS

FIGURE 4

GYPSIZER.DRW

FILE: 98125-10.DRW REVISED BY: PMC DATE: 01/25/01

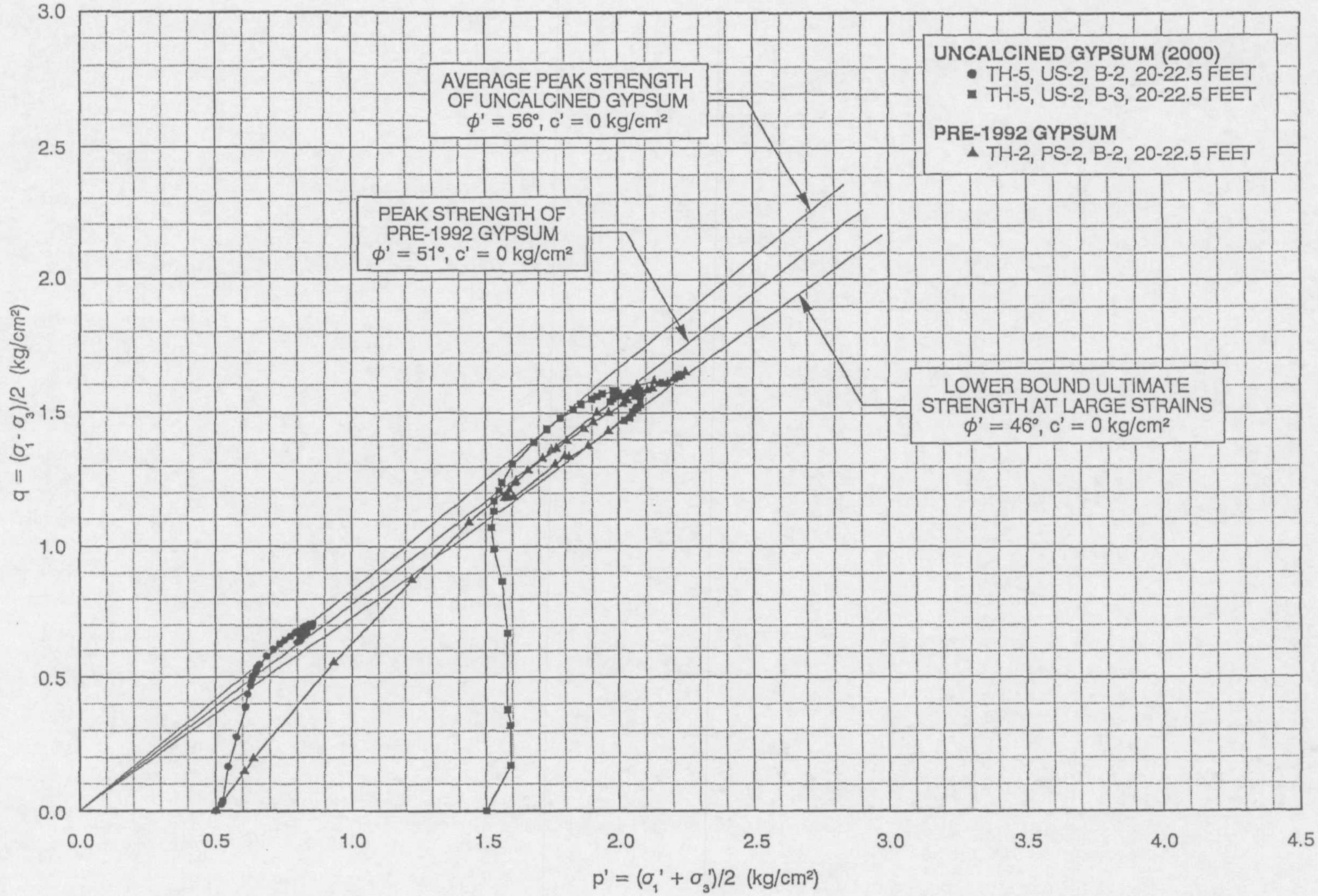


FIGURE 12

EFFECTIVE STRESS PATHS FROM CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED ON UNDISTURBED SAMPLES OF J.R. SIMPLOT PHOSPHOGYPSUM TAKEN FROM A DEPTH OF 20 FEET

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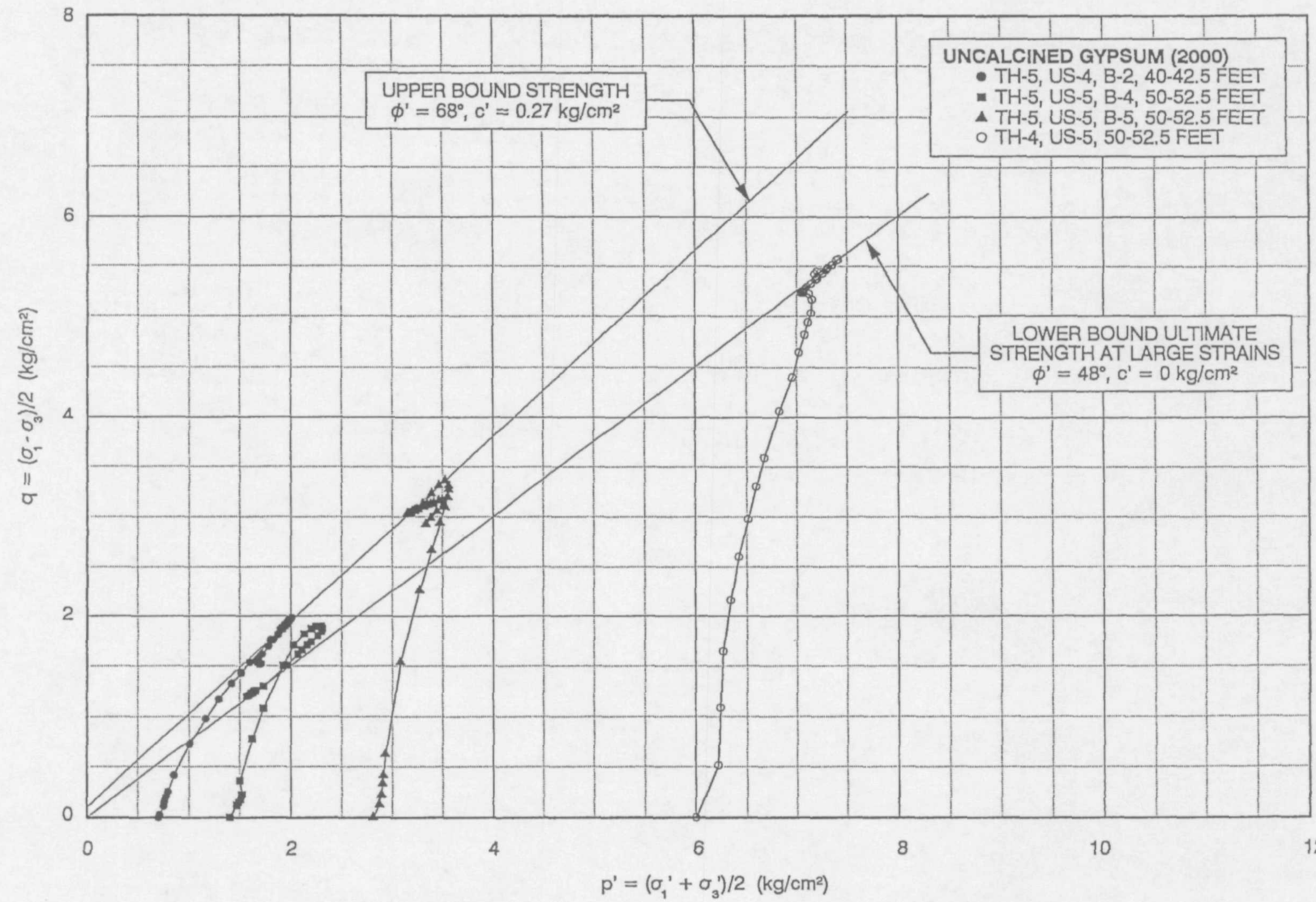

FIGURE 13

EFFECTIVE STRESS PATHS FROM CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED ON UNDISTURBED SAMPLES OF UNCALCINED PHOSPHOGYPSUM TAKEN FROM DEPTHS OF 40 TO 50 FEET

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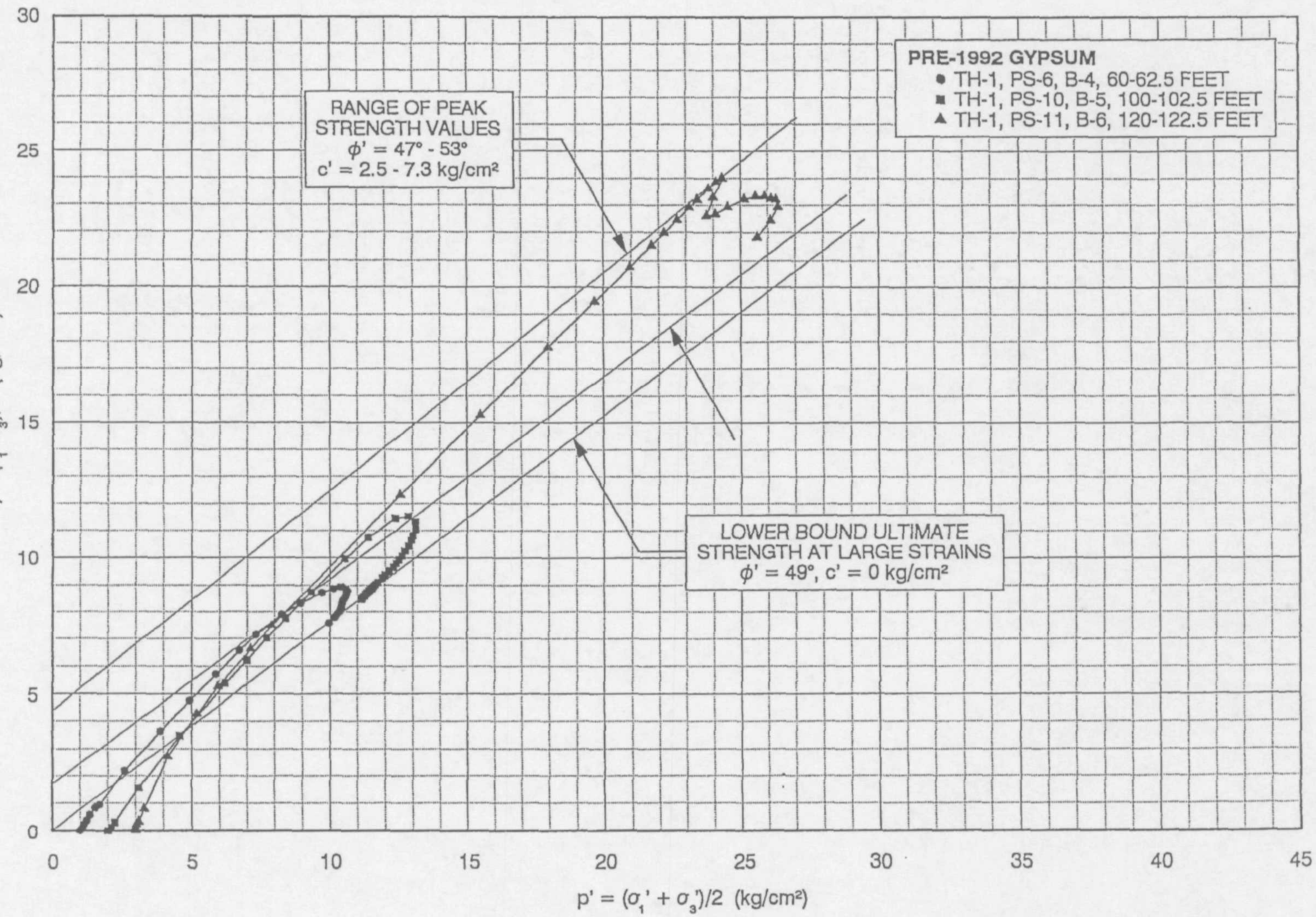

FIGURE 14

EFFECTIVE STRESS PATHS FROM CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED ON UNDISTURBED SAMPLES OF OLDER AND DEEPER PHOSPHOGYPSUM DEPOSITS

FILE: 98125-11.DRW REVISED BY: PMC DATE: 01/25/01

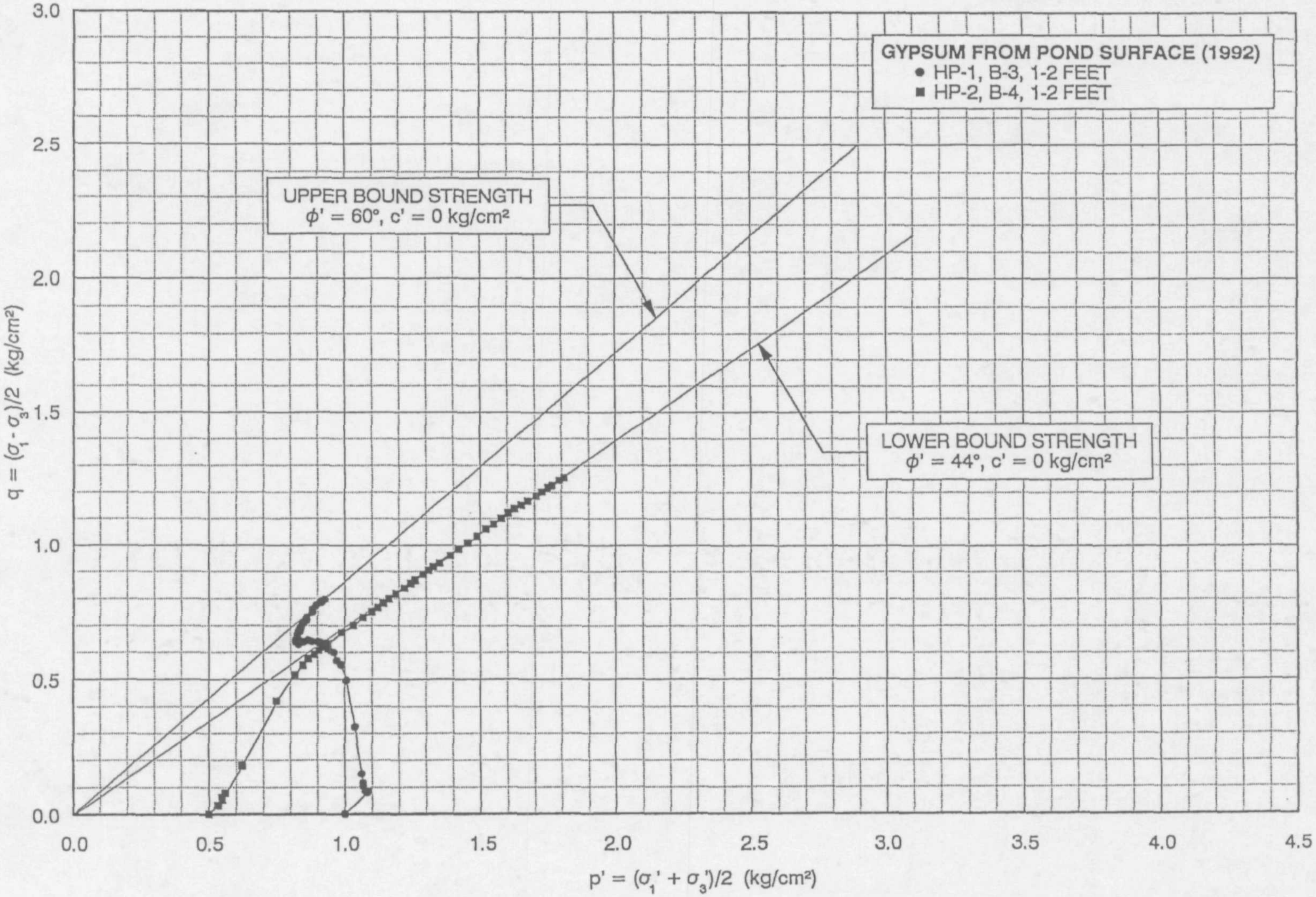

FIGURE 15

EFFECTIVE STRESS PATHS FROM CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS PERFORMED ON UNDISTURBED, NEAR-SURFACE SAMPLES OF J.R. SIMPLOT PHOSPHOGYPSUM OBTAINED FROM 1992 SAMPLING PROGRAM

APPENDIX B

APPENDIX B

Geotextile Design Calculations

MFG, Inc.

Calculation/Computation Set
Cover Sheet Review Documentation

Title of Project: SIMPLOT PLANT AREA EMF SUPERFUND SITE	Job Number: 01-0121	Task: 3
Title of Calculations: GEOFABRIC DESIGN REQUIREMENTS GYPSUM STACK ROADS		

Calcuations By: DEP	Print Name: DAN PASTOR Signature: Dan Pastor	Date 11/18/02
Assumptions Checked By: (Senior Personnel)	Print Name: John H. Rahe Signature: John H. Rahe	Date 11/19/02
Calculations Checked By:	Print Name: JIM KIENHOLZ Signature: Jim Kienholz	Date 11/18/02
The Reviewer's/Checker's comments have been discussed with the Reviewer/Checker, and all significant issues have been resolved.		
Calculation Originator:	Print Name: DAN PASTOR Signature: Dan Pastor	Date 11/19/02
Reviewer/Checker:	Print Name Signature: JHR	Date
Apprived By: (Principal Investigator or Project Manager:	Print Name Signature	Date

Reviewer/Checker Approval (Approval Notes: If calculation are only spot checked, do not require checking, or are assumed to be correct by experience or engineering judgement, it should be noted here.)

Revision Number	Date	By:	Checked By:	Approval:
1				
2	Date	By:	Checked By:	Approval:

Subject GEOFABRIC DESIGN - GYPSUM STACK ROADS
Project No. 01-0121 - 3
By DEP
Checked By
Task No.
File No.
Date 11/18/02
Date
Sheet 1 of 5

UNPAVED ROAD DESIGN

PURPOSE: TO IDENTIFY MATERIAL REQUIREMENTS FOR A GEOTEXTILE THAT WILL BE PLACED UNDER 6-INCHES OF COMPACTED 3/4" ROAD BASE ON PERMANENT GYPSUM STACK ROADS.

BASIS: STACK IS COMPRISED OF GYPSUM WHICH HAS RELATIVELY HIGH BEARING CAPACITY BASED ON GEOTECHNICAL TESTING (ϕ =44° ; C=0, MIN) AND SITE EXPERIENCE.

MAXIMUM LOAD - DUMP TRUCK OR FUEL TRUCK W/ TIRE PRESSURE OF 100 PSI

DESIGN PROCESS:

① AS SUBGRADE IS RELATIVELY STRONG & GEOTEXTILE IS NOT NEEDED FOR REINFORCEMENT. ∴ DESIGN WILL BE FOR SEPARATION IN ACCORDANCE WITH THE PROCEDURE SPECIFIED IN "DESIGNING WITH GEOSYNTHETICS" BY KOERNER; 4TH ED.

AS SPECIFIED IN KOERNER, DESIGNING FOR SEPARATION IS APPROPRIATE WHEN THE SOIL SUBGRADE IS "REASONABLY FIRM" & IT IS NOT EXPECTED THAT SUBGRADE DEFORMATIONS WILL BE SO LARGE AS TO MOBILIZE UNIFORMLY HIGH TENSILE STRESS TO THE GEOTEXTILE. RATHER, THE DEFORMATIONS ARE EXPECTED TO BE LOCALIZED & OCCUR AROUND INDIVIDUAL STONE PARTICLES.

IN SUCH SITUATIONS, THE GEOTEXTILE SHOULD BE DESIGNED FOR BURST RESISTANCE, TENSILE STRENGTH & PUNCTURE RESISTANCE.

Subject GEO FABRIC DESIGN - GYPSUM STACK ROADS

Project No. 61-0121-3

Task No.

By DEP Checked By

File No.

Date 11/18/06 Date

Sheet 2 of 5

A. BURST RESISTANCE

TIRE PRESSURE : 100 PSI CONSERVATIVE ESTIMATE FOR
(P') DUMP TRUCK & FUEL/SERVICE TRUCK

$$\frac{100 \text{ lbs}}{\text{in}^2} \left| \frac{\text{Pa}}{1.45 \times 10^{-4} \frac{\text{lb}}{\text{in}^2}} \right| \frac{\text{KPa}}{1000 \text{ Pa}} = 690 \text{ KPa}$$ ✓

NOTE: Conservatively does not include load dissipation by road base layer

AVERAGE STONE SIZE : SEE ATTACHED IDAHO DOT SPECS
(d_a) & 50% PASSING EVALUATION (A)

AVERAGE STONE SIZE ≈ 3.6 mm ✓

COMMULATIVE REDUCTION FACTORS :
(πRF)

$$\pi RF = RF_{ID} \times RF_{CR} \times RF_{CD} \times RF_{BD}$$

where RF_{ID} = INSTALLATION DAMAGE
RF_{CR} = CREEP
RF_{CD} = CHEMICAL DAMAGE
RF_{BD} = BIOLOGICAL DAMAGE

BASED ON TYPICAL VALUES SHOWN IN ATTACHMENT B (B)
& ALLOWING CHEMICAL DAMAGE BY CONTACT w/ GYPSUM

$$\pi RF = 1.5 \times 1.5 \times 1.5 \times 1.0$$

$$= 3.4$$ ✓

FACTOR OF SAFETY = 2.0 (ASSUMED)

FROM KOERNER

$$FS = \frac{P_{TEST}\, d_{TEST}}{(\pi RF)\, P'\, d_v}$$

where: d_{TEST} = 30 mm (based on ASTM 3786)

$d_v \approx 0.33 d_a$

$$\therefore \quad P_{TEST} = \frac{FS\,(\pi RF)\,P'\,(0.33)\,d_a}{d_{TEST}}$$

$$= \frac{(2.0)(3.4)(690\ kPa)(0.33)(3.6mm)}{30\ mm}$$

$$P_{TEST} = 185\ kPa$$

∴ REQUIRED BURST RESISTANCE

= 185 kPa

BECAUSE PARTICLE SIZE CAN HAVE A SIGNIFICANT EFFECT ON BURST, A MORE CONSERVATIVE DESIGN WOULD BE BASED ON THE MAXIMUM PARTICLE SIZE

d_{max} = 25 mm (1.0 inch)

SINCE ALL MATERIALS MUST BE SMALLER THAN 1 INCH TO MEET DOT SPECS.

$$\therefore \quad P_{TEST} = \frac{FS\,(\pi RF)\,P'\,(0.33)\,d_{max}}{d_{TEST}}$$

$$= \frac{(2.0)(3.4)(690\ kPa)(0.33)(25mm)}{30\ mm}$$

$$= 1,290\ kPa$$

BASED ON ASTM 3786 test d = 30 mm

which is still at the low end of typical burst resistance range

Subject: GEOFABRIC DESIGN - GYPSUM STACK ROADS		Project No.	01-0121-3
By: DEP	Checked By:	Task No.	
		File No.	
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B. TENSILE STRENGTH (GRAB)

FOLLOWING KOERNER EQ (2.29)

$$T_{reg'd} = p' (d_v)^2 \left[f(\varepsilon) \right]$$

where: $d_v \cong 0.33\, d_a$ (but using $d_a = d_{max}$ for conservatism)

$[f(\varepsilon)] = 0.52$

$$T_{reg'd} = \frac{(690\ kPa)[0.33(25mm)]^2 (0.52)}{} \left| \frac{1000\ Pa}{kPa} \right| \frac{N/m^2}{Pa} \left| \frac{(m)^2}{(1000\ mm)^2} \right.$$

$$= 24.4\ N$$

ALLOWING FOR CUMMULATIVE REDUCTION FACTOR = 3.4

AND SAFETY FACTOR = 2.0

$$T_{ALLOWABLE} = (FS)(\pi RF)(T_{REQ'D})$$

$$= (2.0)(3.4)(24.4\ N)$$

$$= \underline{\underline{166\ N}}$$

AGAIN, VERY LOW RANGE VALUE

C. PUNCTURE RESISTANCE

Following KOERNER EQ (2.30), PUNCTURE RESISTENCE MAY BE EVALUATED BY

$$F_{REQ} = p' d_a^2\, S_1\, S_2\, S_3$$

where: d_a = diameter of penetrating object

S_1 = protrusion factor = $\frac{\text{height of penetration}}{d_a}$

Subject GEO FABRIC DESIGN - GYPSUM STACK ROADS | Project No. 01-0121-3

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| File No.

Date 11/18/02 | Date | Sheet 5 of 5

S_2 = scale factor to compensate for diameter of puncturing object relative to the ASTM D 4833 test probe diameter of 8 mm d_{probe}/d_a

S_3 = shape factor for penetrating object as follows $1 - \frac{A_p}{A_c}$
where $\frac{A_p}{A_c}$ is 0.8 - rounded sand
0.7 - river gravel
0.4 - crushed rock

p' = applied pressure (conservatively assumed to equal tire pressure)

The following test case is considered for this evaluation:

A dump truck ($p' = 690$ kPa) drives over a 2 inch (50mm) diameter piece of crushed rock gravel imbeded in the geotextile

$S_1 = 0.33$

$S_2 = \frac{8\text{mm}}{50\text{ mm}} = 0.16$

$S_3 = 1 - 0.4 = 0.6$

$$F_{REQ} = (690\text{ KPa})(50\text{ mm})^2(0.33)(0.16)(0.6) \left| \frac{1000\text{ Pa}}{\text{kPa}} \right| \frac{\text{N/m}^2}{\text{Pa}} \left| \frac{\text{m}^2}{(1000\text{ mm})^2} \right.$$

$= 55$ N ✓

ALLOWING FOR CUMMULATIVE REDUCTION FACTOR = 3.4

AND SAFETY FACTOR = 2.0

$F_{ALLOWABLE} = (FS)(\pi RF)(F_{REQ})$

$= (2.0)(3.4)(55\text{ N})$

$= \underline{\underline{371\text{ N}}}$ ✓ relative to ASTM 4833

IDOT Specs.

ATTACHMENT A-1

703.04 Aggregate for Untreated Base, Treated Base and Road Mix. Aggregate shall conform to one of the following gradations as specified:

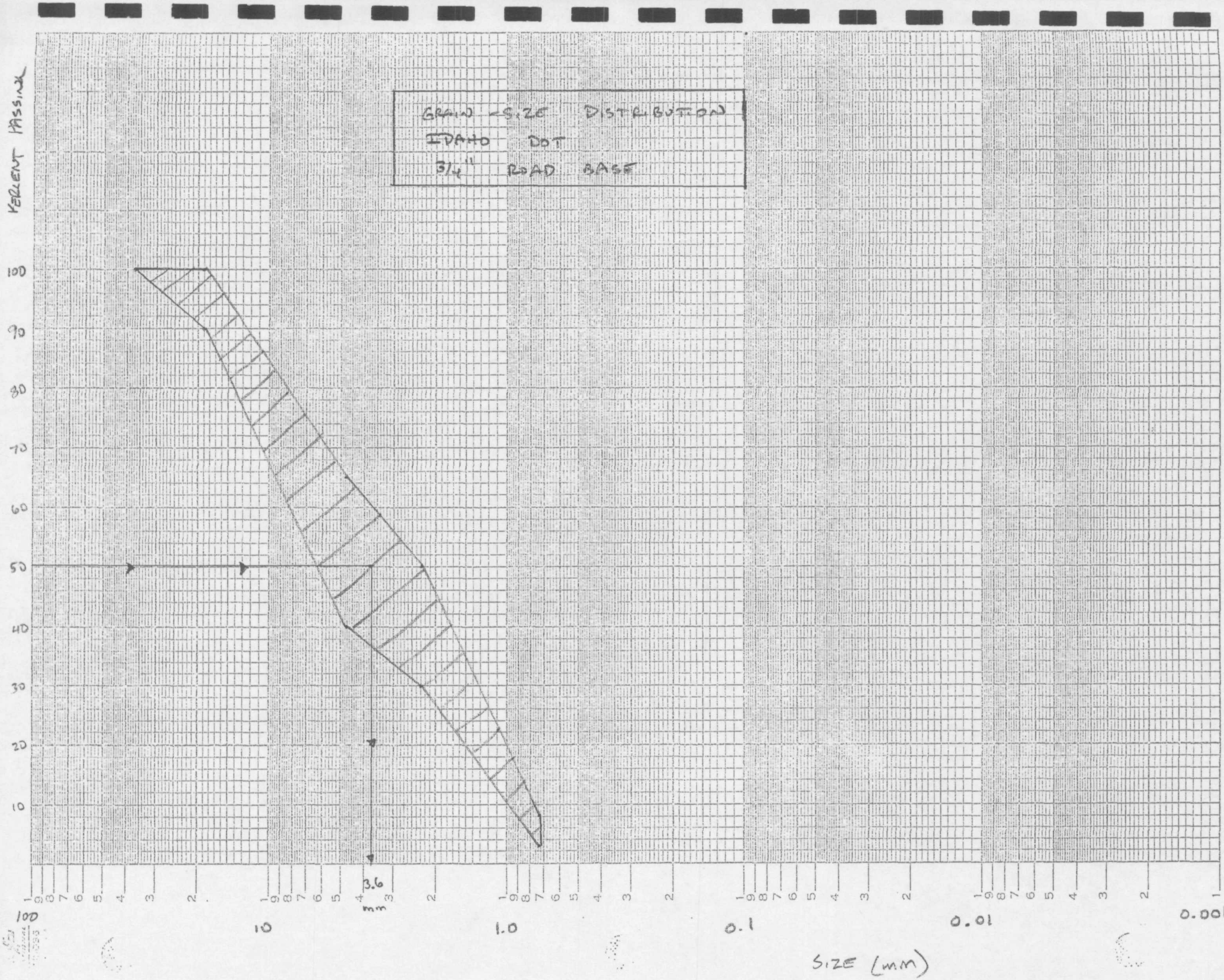
	NOMINALMAXIMUM SIZE					
SIEVE SIZE	9.5 mm (3/8 in.)	12.5mm (1/2 in.)	19 mm (3/4 in.)	25 mm (1 in.)A	25 mm (1 in.)B	50mm (2 in.)
	PERCENT PASSING					
63 mm (2 1/2 in.)						100
50 mm (2 in.)					100	90-100
37.5mm (1 1/2 in.)				100		
25 mm (1 in.)			100	90-100	90-100	55-83
19 mm (3/4 in.)		100	90-100			
12.5 mm (1/2 in.)	100	90-100		60-80	65-100	
9.5mm (3/8 in.)	85-100					
4.75mm (No. 4)	55-75	50-70	40-65	35-60	40-80	30-60
2.36 mm (No. 8)	40-60	35-55	30-50	25-50	30-60	
0.60 mm (No. 30)	20-40	12-30		10-30	15-35	10-25
0.075 mm (No. 200)	3-9	3-9	3-9	2-9	6-18	0-8

The sand equivalent shall not be less than 30 if 5 percent or more of the material passes the 0.075 mm (No. 200) sieve. Sand equivalent will not be required if less than 5 percent passes the 0.075 mm (No. 200) sieve, or for aggregate to be used for lime or cement treated base.

The aggregate shall not show a loss of more than 30 in the Los Angeles Abrasion Test. The material shall have a minimum R – value of 75 as measured by Idaho T-8. When tested in accordance with AASHTO T 182, aggregate for road mix shall have a retained asphalt film above 95 percent. Road mix aggregate not meeting this requirement may be used in combination with an anti-strip agent, provided the combination meets the 95 percent requirement.

The percentage of aggregate retained on the 4.75 mm (No. 4) sieve having at least one fractured face as determined by Idaho T-71 shall be 60 percent for untreated base and 75 percent for treated base and road mix.

703.05 Aggregate for Plant Mix Pavement. The aggregate for Class I and Class II mix shall be provided in separate stockpiles. Aggregate from state-controlled sources for Class III mix shall also meet these



ATTACHMENT A-2

SEMI-LOGARITHMIC, 5 CYCLES X 10 TO THE INCH
5TH LINES ACCENTED

Designing with Geosynthetics 4th Ed
Koerner '98

B-1

TABLE 2.12 RECOMMENDED REDUCTION FACTOR VALUES FOR USE IN EQ. (2.25a)

	Range of Reduction Factors				
Application	Soil Clogging and Blinding*	Creep Reduction of Voids	Intrusion into Voids	Chemical Clogging†	Biological Clogging
Retaining wall filters	2.0 to 4.0	1.5 to 2.0	1.0 to 1.2	1.0 to 1.2	1.0 to 1.3
Underdrain filters	5.0 to 10	1.0 to 1.5	1.0 to 1.2	1.2 to 1.5	2.0 to 4.0
Erosion-control filters	2.0 to 10	1.0 to 1.5	1.0 to 1.2	1.0 to 1.2	2.0 to 4.0
Landfill filters	5.0 to 10	1.5 to 2.0	1.0 to 1.2	1.2 to 1.5	5 to 10‡
Gravity drainage	2.0 to 4.0	2.0 to 3.0	1.0 to 1.2	1.2 to 1.5	1.2 to 1.5
Pressure drainage	2.0 to 3.0	2.0 to 3.0	1.0 to 1.2	1.1 to 1.3	1.1 to 1.3

*If stone riprap or concrete blocks cover the surface of the geotextile, use either the upper values or include an additional reduction factor.

†Values can be higher particularly for high alkalinity groundwater.

‡Values can be higher for turbidity and/or for microorganism contents greater than 5000 mg/l.

$$q_{\text{allow}} = q_{\text{ult}}\left(\frac{1}{\Pi \text{RF}}\right) \tag{2.25b}$$

where

q_{allow} = allowable flow rate,
q_{ult} = ultimate flow rate,
RF_{SCB} = reduction factor for soil clogging and blinding,
RF_{CR} = reduction factor for creep reduction of void space,
RF_{IN} = reduction factor for adjacent materials intruding into geotextile's void space,
RF_{CC} = reduction factor for chemical clogging,
RF_{BC} = reduction factor for biological clogging, and
ΠRF = value of cumulative reduction factors.

As with Eqs. (2.24) for strength reduction, this flow-reduction equation could also have included additional site-specific terms, such as blocking of a portion of the geotextile's surface by riprap or concrete blocks.

2.5 DESIGNING FOR SEPARATION

Application areas for geotextiles used for the separation function were given in Section 1.3.3. There are many specific applications, and it could be said, in a general sense, that geotextiles always serve a separation function. If they do not also serve this function, any other function, including the primary one, will not be served properly. This should not give the impression that the geotextile function of separation always plays a secondary role. Many situations call for separation only, and in such cases the geotextiles serve a significant and worthwhile function.

B-2

2.5.1 Overview of Applications

Perhaps the target application that best illustrates the use of geotextiles as separators is their placement between a reasonably firm soil subgrade (beneath) and a stone base course, aggregate, or ballast (above). We say "reasonably firm" because it is assumed that the subgrade deformation is not sufficiently large to mobilize uniformly high tensile stress in the geotextile. (The application of geotextiles in unpaved roads on soft *soils with membrane-type reinforcement is treated later in Section* 2.6.1.) Thus for a separation function to occur the geotextile has only to be placed on the soil subgrade and then have stone placed, spread, and compacted on top of it. The subsequent deformations are very localized and occur around each individual stone particle. A number of scenarios can be developed showing which geotextile properties are required for a given situation.

2.5.2 Burst Resistance

Consider a geotextile on a soil subgrade with stone of average particle diameter (d_a) placed above it. If the stone is uniformly sized, there will be voids within it that will be available for the geotextile to enter. This entry is caused by the simultaneous action of the traffic loads being transmitted to the stone, through the geotextile, and into the underlying soil. The stressed soil then tries to push the geotextile up into the voids within the stone. The situation is shown schematically in Figure 2.28. Giroud [64] provides a formulation for the required geotextile strength that can be adopted for this application.

$$T_{\text{reqd}} = \frac{1}{2} p' d_v [f(\varepsilon)] \tag{2.26}$$

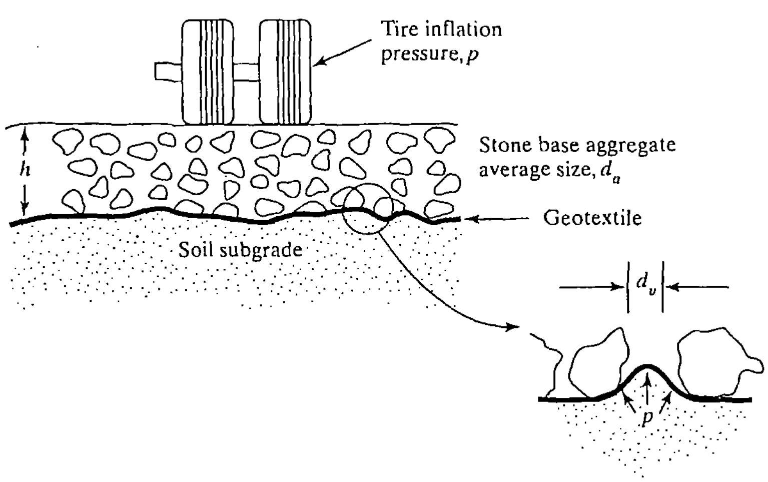


Figure 2.28 Geotextile being forced up into voids of stone base by traffic tire loads.

B-3

where

T_{reqd} = required geotextile burst strength;
p' = stress at the geotextile's surface, which is less than or equal to p, the tire inflation pressure at the ground surface;
d_v = maximum void diameter of the stone $\cong 0.33 d_a$;
d_a = the average stone diameter,
$f(\varepsilon)$ = strain function of the deformed geotextile
$= \frac{1}{4}\left(\frac{2y}{b} + \frac{b}{2y}\right)$, in which
b = width of opening (or void), and
y = deformation into the opening (or void).

The field situation is analogous to the ASTM D3786 (Mullen) burst test, which has the geotextile being stressed into a gradually increasing hemispherical shape until it fails in radial tension (recall Section 2.3.3). Thus, the adapted form of Eq. (2.26) is:

$$T_{ult} = \frac{1}{2} p_{test} d_{test} [f(\varepsilon)] \tag{2.27}$$

where

T_{ult} = ultimate geotextile strength,
p_{test} = burst test pressure, and
d_{test} = diameter of the burst test device (= 30 mm).

Knowing that $T_{allow} = T_{ult}/(\Pi RF)$, where ΠRF = cumulative reduction factors, we can formulate an expression for the FS as follows:

$$FS = \frac{T_{allow}}{T_{reqd}} = \frac{(p_{test} d_{test})}{(\Pi RF) p' d_v}$$

For example, if d_{test} = 30 mm, $d_v = 0.33\, d_a$, and $\Pi FS = 1.5$ (which is not particularly low since creep is not an issue with this application), then the FS is the following, with d_a in mm.

$$FS = \frac{p_{test}(30)}{(1.5)p'(0.33 d_a)}$$

$$FS = \frac{60.6 p_{test}}{p' d_a} \tag{2.28}$$

Example 2.7

Given a 700 kPa truck tire inflation pressure on a poorly graded stone-base course consisting of 50 mm maximum-size stone, what is the factor of safety using a geotextile with an ultimate burst strength of 2000 kPa and cumulative reduction factors of 1.5?

(B-1)

Solution: Assuming that the tire inflation pressure is not significantly reduced through the thickness of the stone base, we can solve Eq. (2.28) as follows.

$$FS = \frac{60.6(2000)}{700(50)}$$
$$= 3.5$$

Note that with the cumulative reduction factors of 1.5 already included, the resulting factor of safety value is acceptable.

For a range of stone-base particle diameters (d_a), values of tire inflation pressure (p'), and cumulative reduction factors of 1.5, along with a factor of safety of 2.0, we get the design guide in Figure 2.29. Here it can be seen that stone size is quite significant insofar as the required burst-pressure values are concerned. Note also that these are poorly graded aggregates and that the presence of fines will lessen the severity of the design; hence this approach should be considered to be a worst-case design.

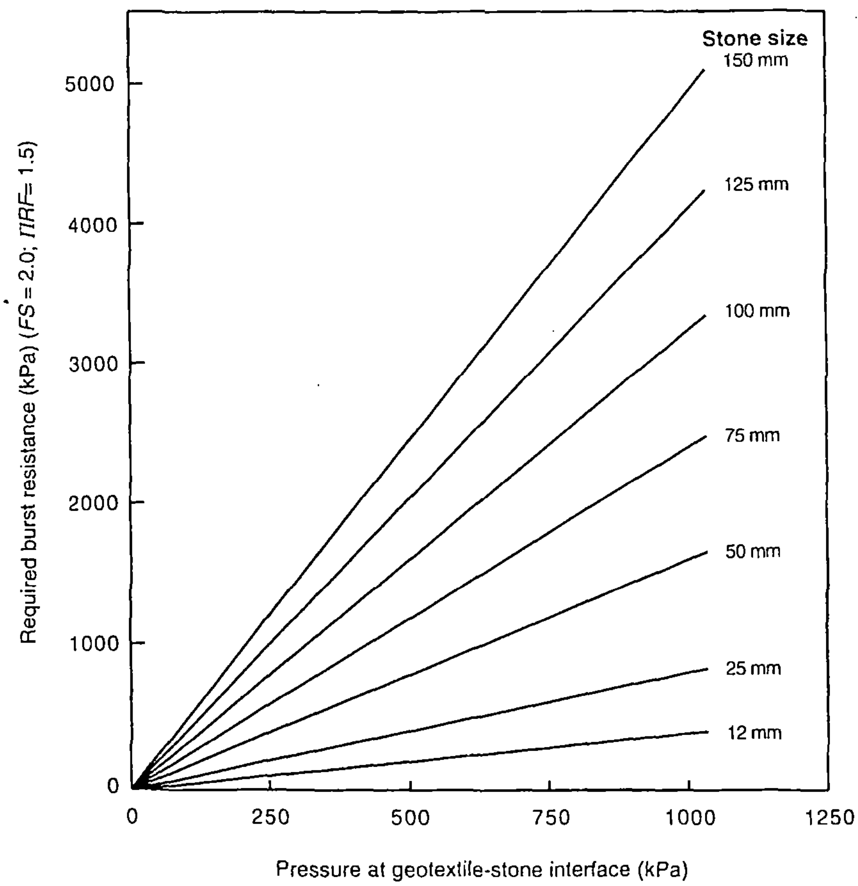


Figure 2.29 Design guide for burst analysis of geotextile used in a separation function based on cumulative reduction factors of 1.5 and a factor of safety of 2.0.

B-5

2.5.3 Tensile Strength Requirement

Continuing the discussion of the general problem, there is a process acting on the geotextile simultaneously as its tendency to burst in an out-of-plane mode: tensile stress mobilized by in-plane deformation. This occurs as the geotextile is locked into position by the stone-base aggregate above it and soil subgrade below it. A lateral or in-plane tensile stress in the geotextile is mobilized when an upper piece of aggregate is forced between two lower pieces that lie against the geotextile. The analogy to the grab tensile test can be readily visualized, as illustrated in Figure 2.30. Here we can estimate the maximum strain that the geotextile will undergo as the upper stone wedges itself down to the level of the geotextile. Using the dimensions shown (where $S \sim d/2$ and l_f = deformed geotextile length), the maximum strain with no slippage or stone breakage can be calculated.

$$\varepsilon = \frac{l_f - l_o}{l_o}(100)$$

$$= \frac{[d + 2(d/2)] - 3(d/2)}{3(d/2)}(100)$$

$$= \frac{4(d/2) - 3(d/2)}{3(d/2)}(100)$$

$$= 33\%$$

Note that the preceding assumptions result in a strain that is independent of particle size. Thus the strain in the geotextile could be as high as 33% given the idealized

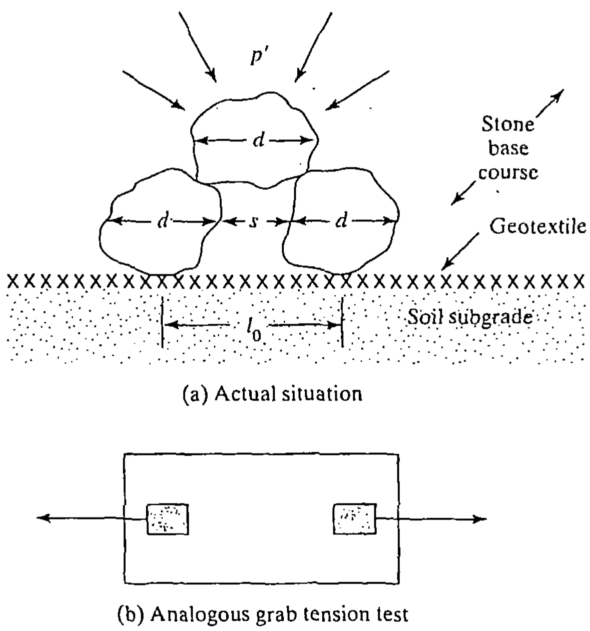


Figure 2.30 Geotextile being subjected to tensile stress as surface pressure is applied and stone base attempts to spread laterally.

B-6

(upper-bound) assumptions stated above. The tensile force being mobilized is related to the pressure exerted on the stone as follows [64].

$$T_{\text{reqd}} = p'(d_v)^2[f(\varepsilon)] \tag{2.29}$$

where

T_{reqd} = required grab tensile force;
p' = applied pressure;
d_v = maximum void diameter $\simeq 0.33\ d_a$, where
d_a = average stone diameter; and
$f(\varepsilon)$ = strain function of the deformed geotextile;
$= \frac{1}{4}\left(\frac{2y}{b} + \frac{b}{2y}\right)$, where
b = width of stone void, and
y = deformation into stone void.

Example 2.8 illustrates the design procedure above.

Example 2.8

Given a 700 kPa truck-tire inflation pressure on a stone-base course consisting of 50 mm *maximum-size stone with a geotextile* beneath it, calculate **(a)** the required grab tensile stress on the geotextile, and **(b)** the factor of safety for a geotextile whose grab strength at 33% is 500 N with cumulative reduction factors of 2.5 and $f(\varepsilon) = 0.52$.

Solution: **(a)** Using an empirical relationship that $d_v = 0.33\ d_a$ and $f(\varepsilon) = 0.52$, the required grab tensile strength from Eq. (2.29) is as follows.

$$\begin{aligned} T_{\text{reqd}} &= p'(d_v)^2(0.52) \\ &= p'(0.33 d_a)^2(0.52) \\ &= 0.057\, p' d_a^2 \\ &= 0.057(700)(1000)(0.050)^2 \\ &= 100 \text{ N} \end{aligned}$$

(b) The factor of safety for a 500 N grab tensile geotextile at 33% strain with cumulative reduction factors of 2.5 is as follows.

$$\begin{aligned} \text{FS} &= \frac{T_{\text{allow}}}{T_{\text{reqd}}} \\ &= \frac{500/2.5}{100} \\ &= 2.0 \qquad \text{which is acceptable.} \end{aligned}$$

2.5.4 Puncture Resistance

The geotextile must survive the installation process. This is not just related to the function of separation; indeed, fabric survivability is critical in all types of applications—without it the best of designs are futile (recall Figure 2.19). In this regard, sharp stones,

(B-7)

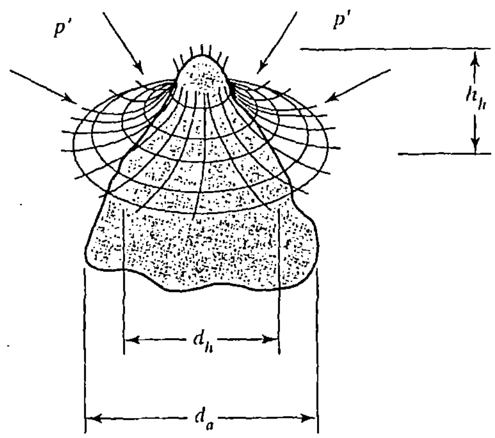


Figure 2.31 Visualization of a stone puncturing a geotextile as pressure is applied from above.

tree stumps, roots, miscellaneous debris, and other items, either on the ground surface beneath the geotextile or placed above it, could puncture through the geotextile after backfilling and traffic loads are imposed. The design method suggested for this situation is shown schematically in Figure 2.31. For these conditions, the vertical force exerted on the geotextile (which is gradually tightening around the protruding object) is as follows:

$$F_{\text{reqd}} = p' d_a^2 S_1 S_2 S_3 \tag{2.30}$$

where

- F_{reqd} = required vertical force to be resisted;
- d_a = average diameter of the puncturing aggregate or sharp object;
- p' = pressure exerted on the geotextile (approximately 100% of tire inflation pressure at the ground surface for thin covering thicknesses);
- S_1 = protrusion factor = h_h/d_a;
- h_h = protrusion height $\leqslant d_a$;
- S_2 = scale factor to adjust the ASTM D4833 puncture test value (which uses an 8.0 mm diameter puncture probe) to the diameter of the actual puncturing object = d_{probe}/d_a;
- S_3 = shape factor to adjust the ASTM D4833 flat puncture probe to the actual shape of puncturing object = $1 - A_p/A_c$, (values for A_p/A_c range from 0.8 for rounded sand, to 0.7 for run-of-bank gravel, to 0.4 for crushed rock, to 0.3 for shot rock);
- A_p = projected area of puncturing particle;
- A_c = area of smallest circumscribed circle around puncturing particle.

Example 2.9

What is the factor of safety against puncture of a geotextile from a 50 mm stone on the ground surface mobilized by a loaded truck with a tire inflation pressure of 550 kPa traveling on the surface of the base course? The geotextile has an ultimate puncture strength of 200 N, according to ASTM D4833.

B-8

TABLE 2.11 RECOMMENDED REDUCTION FACTOR VALUES FOR USE IN EQ. (2.24a)

Application Area	Range of Reduction Factors: Installation Damage	Creep*	Chemical Degradation	Biological Degradation
Separation	1.1 to 2.5	1.5 to 2.5	1.0 to 1.5	1.0 to 1.2
Cushioning	1.1 to 2.0	1.2 to 1.5	1.0 to 2.0	1.0 to 1.2
Unpaved roads	1.1 to 2.0	1.5 to 2.5	1.0 to 1.5	1.0 to 1.2
Walls	1.1 to 2.0	2.0 to 4.0	1.0 to 1.5	1.0 to 1.3
Embankments	1.1 to 2.0	2.0 to 3.5	1.0 to 1.5	1.0 to 1.3
Bearing capacity	1.1 to 2.0	2.0 to 4.0	1.0 to 1.5	1.0 to 1.3
Slope stabilization	1.1 to 1.5	2.0 to 3.0	1.0 to 1.5	1.0 to 1.3
Pavement overlays	1.1 to 1.5	1.0 to 2.0	1.0 to 1.5	1.0 to 1.1
Railroads (filter/sep.)	1.5 to 3.0	1.0 to 1.5	1.5 to 2.0	1.0 to 1.2
Flexible forms	1.1 to 1.5	1.5 to 3.0	1.0 to 1.5	1.0 to 1.1
Silt fences	1.1 to 1.5	1.5 to 2.5	1.0 to 1.5	1.0 to 1.1

*The low end of the range refers to applications which have relatively short service lifetimes and/or situations where creep deformations are not critical to the overall system performance.

where

T_{allow} = allowable tensile strength,
T_{ult} = ultimate tensile strength,
RF_{ID} = reduction factor for installation damage,
RF_{CR} = reduction factor for creep,
RF_{CD} = reduction factor for chemical degradation,
RF_{BD} = reduction factor for biological degradation, and
ΠRF = value of cumulative reduction factors.

Note that Eq. (2.24a) could have included additional site-specific terms, such as reduction factors for seams and intentionally made holes. It also could have been formulated with fractional multipliers (values $\leqslant 1.0$) placed in the numerator of the equation or on the opposite side of the equation, as with the *load-factor design method*. It has been put in this form following other studies (e.g., Voskamp and Risseeuw [63]). While the equation indicates tensile strength, it can be applied to burst strength, tear strength, puncture strength, impact strength, and so on.

2.4.2 Flow-Related Problems

For problems dealing with flow through or within a geotextile, such as filtration and drainage applications, the formulation of the allowable values takes the following form. Typical values for reduction factors are given in Table 2.12. Note that these values must be tempered by the site-specific conditions, as in Section 2.4.1. If the laboratory test includes the mechanism listed, it appears in the equation as a value of 1.0.

$$q_{\text{allow}} = q_{\text{ult}}\left(\frac{1}{\text{RF}_{SCB} \times \text{RF}_{CR} \times \text{RF}_{IN} \times \text{RF}_{CC} \times \text{RF}_{BC}}\right)$$

APPENDIX C

APPENDIX C

Construction Drawings

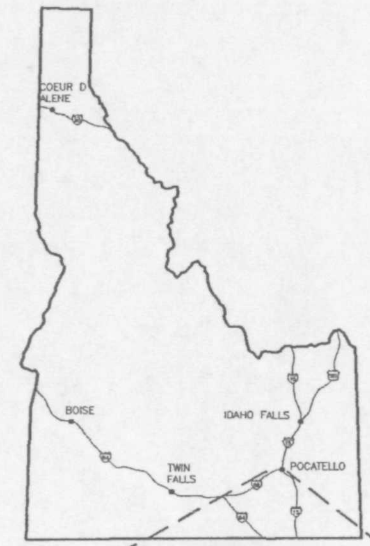
EASTERN MICHAUD FLATS SUPERFUND SITE

POCATELLO, IDAHO

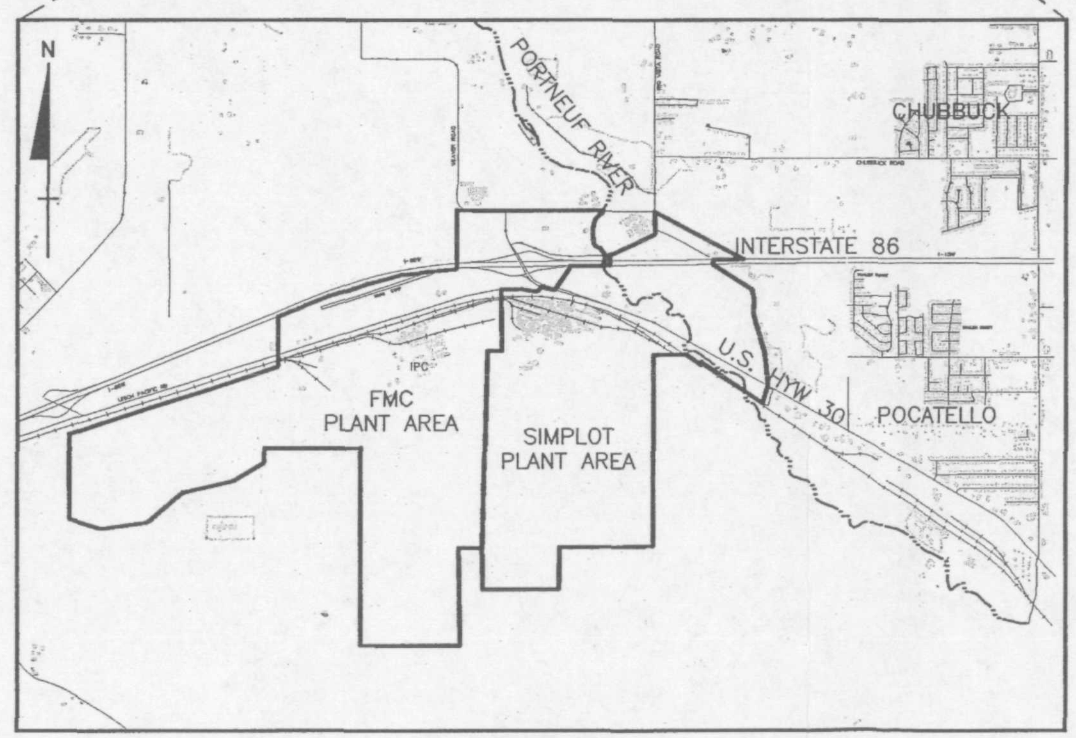
SIMPLOT PLANT AREA
GYPSUM STACK ROADS PROJECT

SHEET TITLE	SHEET NO.
LOCATION & VICINITY MAPS & TITLE SHEET	0121G-110
GYPSUM STACK ROADS	0121C-110
TYPICAL SECTION & DETAILS	0121C-111

DRAFT
Not For Construction



IDAHO
Location Map



VICINITY MAP
SCALE
0.5 0 0.5 MILE

MFG
consulting scientists and engineers
4900 Pearl East Circle, Suite 300W,
Boulder, Colorado 80301
Phone (303) 447-1823
Fax (303) 447-1836

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REFERENCE

NO.	REVISIONS	BY	DATE
0	ISSUE FOR REVIEW	DLL	05/02
1	REVISED BARRIER AREAS AND SEAM/ ANCHOR METHOD, REISSUE FOR REVIEW	DEP	11/02

DESIGNED BY:	DLL
DRAWN BY:	SCG
CHECKED BY:	ACK
APPROVED BY:	DEP
CTB:	MFG-STD
VIEW NAME:	PLAN
ORIGINATION DATE:	05/21/02
PLOT SCALE:	1:1 OR 1:2
DATE:	MAY 2002

EASTERN MICHAUD FLATS
POCATELLO, IDAHO
SIMPLOT PLANT AREA
GYPSUM STACK ROADS RA

LOCATION & VICINITY MAPS & TITLE SHEET

DRAWING NO. 0121G-110
REV.NO. 1
SHEET 1 OF 3

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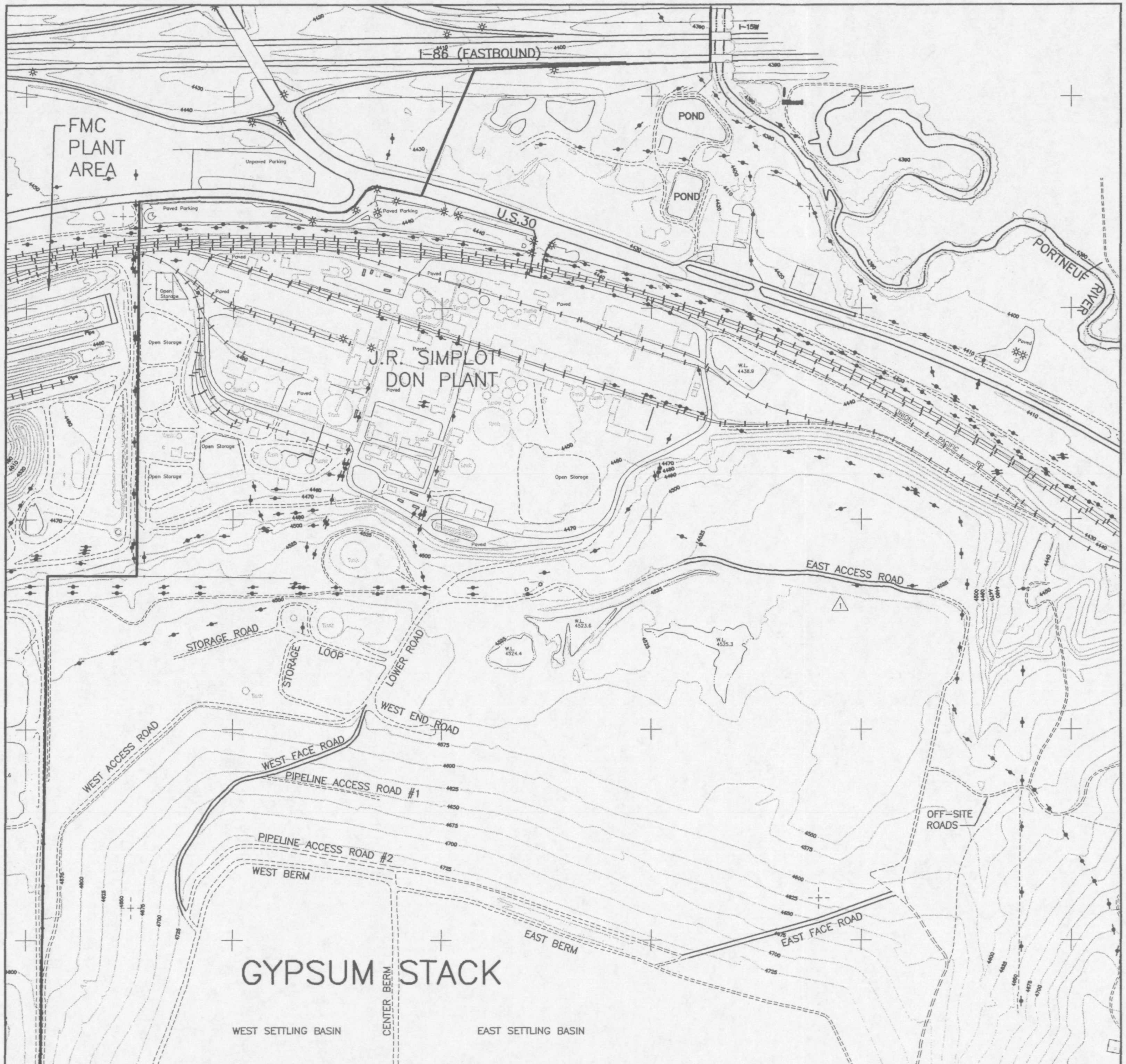

LEGEND:

BARRIER INSTALLATION AREAS

NOTES:

1. CONTRACTOR MUST COMPLY WITH ALL SIMPLOT TRAFFIC AND SAFETY RULES AND REGULATIONS WHEN TRAVELING THROUGH THE DON PLANT.
2. ALL HAUL TRAFFIC MUST BE CONFINED TO DESIGNATED HAUL ROUTES.
3. GRADE BARRIER INSTALLATION AREAS. INSTALL NON-WOVEN GEOTEXTILE AND PLACE SIX INCHES OF GRAVEL ROAD BASE.

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N

SCALE
250 0 250 FEET

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REFERENCE

– BECHTEL ENVIRONMENTAL, INC., DATE OF PHOTOGRAPHY: 21JUNE92 DATE OF MAPPING: AUGUST 92 MAPPING AND PHOTOGRAPHY BY WALKER AND ASSOCIATES, INC. SEATTLE, WASHINGTON. SEATTLE, WASHINGTON

NO.	REVISIONS	BY	DATE
0	ISSUE FOR REVIEW	DLL	05/02
1	REVISED BARRIER AREAS AND SEAM/ ANCHOR METHOD, REISSUE FOR REVIEW	DEP	11/02

DESIGNED BY:	DLL
DRAWN BY:	SCG
CHECKED BY:	ACK
APPROVED BY:	DEP
CTB:	MFG-STD
VIEW NAME:	PLAN
ORIGINATION DATE:	04/29/02
PLOT SCALE:	1:1 OR 1:2
DATE:	MAY 2001

EASTERN MICHAUD FLATS
POCATELLO, IDAHO

SIMPLOT PLANT AREA
GYPSUM STACK ROADS RA

GYPSUM STACK ROADS SITE PLAN

DRAWING NO. 0121C-110
REV.NO. 1
SHEET 2 OF 3

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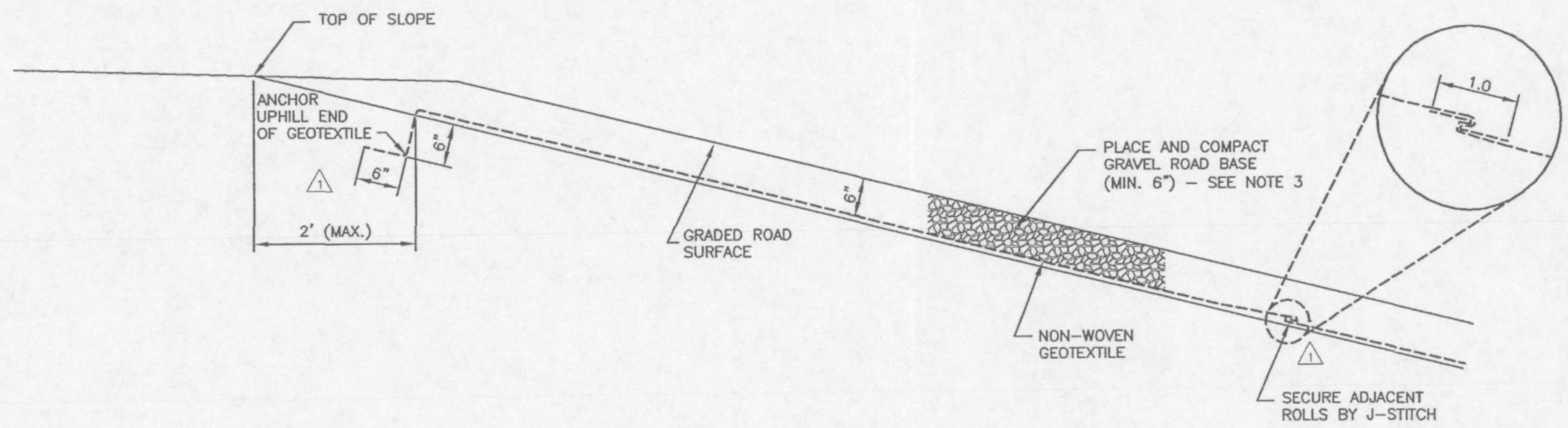

TYPICAL ROAD SECTION / PROFILE

NOT TO SCALE

DRAFT
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NOTES:

1. PRIOR TO PLACEMENT OF FABRIC AND GRAVEL GRADE, MOISTURE CONDITION AND COMPACT EXISTING ROAD SURFACE USING A SMOOTH DRUM OR RUBBER-TIRED COMPACTOR, 4 PASSES MINIMUM.
2. GRADE ROAD SURFACE TO ACCOMMODATE GRAVEL PLACEMENT WITH A SLIGHT SLOPE ACROSS THE ROAD FROM OUTSIDE TO INSIDE EDGE.
3. ADD WATER TO GRAVEL ROAD BASE TO ACHIEVE MOISTURE CONTENT WITHIN 2% OF OPTIMUM MOISTURE CONTENT AND COMPACT TO ACHIEVE 90% OF MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D-698.

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REFERENCE

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NO.	REVISIONS	BY	DATE
0	ISSUE FOR REVIEW	DLL	05/02
1	REVISED BARRIER AREAS AND SEAM/ ANCHOR METHOD, REISSUE FOR REVIEW	DEP	11/02

DESIGNED BY:	DLL
DRAWN BY:	RHF
CHECKED BY:	ACK
APPROVED BY:	DEP
CTB:	MFG-STD
VIEW NAME:	PLAN
ORIGINATION DATE:	04/29/02
PLOT SCALE:	1:1 OR 1:2
DATE:	JUNE 2002

EASTERN MICHAUD FLATS
POCATELLO, IDAHO
SIMPLOT PLANT AREA
GYPSUM STACK ROADS RA

TYPICAL SECTIONS & DETAILS

DRAWING NO. 0121C-111 REV.NO. 1

SHEET 3 OF 3

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APPENDIX D

APPENDIX D

Contractor Statement of Work/Specifications

SIMPLOT PLANT AREA
GYPSUM STACK ROADS PROJECT
POCATELLO, IDAHO

STATEMENT OF WORK / PROJECT SPECIFICATIONS

A. Background Information

The Eastern Michaud Flats (EMF) Superfund Site Gypsum Stack Roads Project consists of overlaying the permanent Gypsum Stack roads on the face of the stack with geotextile and gravel road base to reduce visible fugitive emissions generated by vehicular traffic. The permanent roads contain an overall length of approximately 3,700 feet (see Drawing 0121C-111). These roads are traveled by wheeled vehicles transporting employees to work on the stack, maintenance and fueling vehicles, and tracked equipment used at various locations around the plant.

This project is being conducted by the J.R. Simplot Company, hereinafter referred to as the Owner, in accordance with a Remedial Action Work Plan prepared as directed under a Consent Decree between Simplot and the US Environmental Protection Agency.

B. Supervision

All work will be performed in the presence of an authorized representative of the Owner or designated Field Supervisor. The Field Supervisor will be the Owner's representative during construction to monitor the progress of construction and the quality of the work, and to record the data necessary to document the satisfactory completion of the project. The Field Supervisor will not be responsible for construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs required for the work.

The Contractor shall maintain a competent staff at all times to supervise and perform the work. The Contractor shall maintain on the project during its progress, a competent supervisor, satisfactory to the Owner.

C. Contractor Health & Safety

The Contractor acknowledges that the gypsum may pose a potential inhalation risk, and shall conduct all construction activities in a manner to minimize this risk. Contractor shall prepare for and conduct all operations at the site in a manner to avoid risk of bodily harm to persons or damage to property and in full compliance with OSHA, the health and safety provisions of the contract documents, site-specific health and safety requirements of the Simplot Don Plant and any and all other applicable authorities. Contractor shall prepare and submit a site specific Health and Safety Plan (HASP) that includes a construction safety program. The HASP shall be prepared in accordance with provisions in 29 CFR 1910.120, Simplot Don Plant requirements, Simplot's Health and Safety Plan for the project, and other federal, state and local regulations. All contractor personnel on-site must comply with the training requirements of OSHA contained in 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER).

D. Contractor Scope of Work

Upon receipt of notice to proceed by Owner, Contractor will mobilize personnel, equipment, and materials to the site. Contractor shall use an adequate number of skilled workers experienced in the type of work to be performed. Prior to the start of start of Work, contractor shall be solely responsible for locating utilities in and around the work area. Care will be taken to identify all possible underground and overhead hazards. Contractor shall provide portable sanitation facilities for on-site personnel at the work area. Contractor shall keep the site free from any unnecessary accumulation of waste materials and rubbish and shall maintain the site in a safe and tidy condition at all times. Simplot maintains access control to all areas of the Don Plant, and additional site security on the part of the Contractor is not anticipated. Work activities are to be coordinated with on-going operations and scheduled during a time when the effects on plant operations can be minimized. Work is to be avoided at times when excavation and transportation activities may be hindered by frozen or excessively wet ground.

Prior to the placement of the geotextile fabric and gravel road base the full width of the roadway areas to receive the geotextile and road base (approximately 12 feet) are to be graded to remove loose material and create a smooth surface. The graded surfaces are then to be moisture conditioned through the application of water and compacted with a smooth drum or rubber tired compactor a minimum of four passes, or until a stable subgrade is achieved. Only as much subgrade as can be covered by the end of the workday is to be prepared on any given day. Grade roads with a slight slope across the road surface from the outside edge of the road to the inside.

Once grading and subgrade preparation is complete, and approved by the field supervisor, place on the road surface an approved non-woven geotextile listed on Table 1 or an approved equivalent material that meets the listed minimum requirements for burst resistance, tensile strength, and puncture resistance.

Anchor the uphill edge of each roll in a shallow, six-inch anchor trench to avoid slippage, and overlap adjacent rolls in the downhill direction a minimum of 1 foot and secure the overlapped materials by sewing using a j-stitch (See Drawing 0121C-112).

Contractor will use gravel road base with a maximum aggregate size of ¾-inch. This material shall meet the specifications of the Idaho Department of Transportation (IDOT) standard specifications for aggregate for untreated base, treated base and road mix contained in Section 703.04 of the IDOT highway specifications manual. Gravel road base is to be placed in loose lifts of approximately 7 to 8 inches (or as necessary to achieve a compacted thickness of 6 inches). Gravel road base is to be moisture conditioned as necessary and compacted to achieve at least 90 percent of the maximum dry density as determined by the Standard Proctor Test (ASTM D-698) at a moisture content within 2 percent of optimum moisture content. Contractor is to perform in place field density tests for quality control at a frequency of one test for every 500 linear feet of roadway.

The Contractor is required to maintain a water truck on-site for dust control. Dust control activities are to be performed to minimize dust emissions from the site. Apply water, as necessary, to the haul roads and perimeter work areas, to minimize and control dust emissions. Dust control is to be performed so as not to saturate the soils. Care must be taken to insure no gypsum material is tracked off site.

Following completion of the work, Contractor shall restore all the staging areas to their preconstruction condition and remove all trash and debris, leaving the site in a clean, stable condition.

Table 1

Minimum Material Requirements and Acceptable Materials [1]

		Mullen Burst ASTM D-3786	Grab Tensile ASTM D-4632	Puncture ASTM D-4833
Minimum Requirement		1,300 kPa	170 N	375 N
Product Name	Mass per Unit Area	Minimum Average Roll Value		
Amoco 4506	6 oz/sy	2,135 kPa	710 N	400 N
Amoco 4508	8 oz/sy	2619 kPa	900 N	575 N

[1] Approved equivalent materials will also be acceptable.

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- Texarkana

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